THE HOPE REPORTS

VOL. XIII

1913—1921

THE BIONOMICS (MYRMECOPHILY, MIMICRY, EPIGAMICS, &c.) OF AFRICAN INSECTS

EDITED BY

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THE AMERICAN ENTOMOLOGICAL SOCIETY

'Semper Africa novi aliquid apportat'

OXFORD
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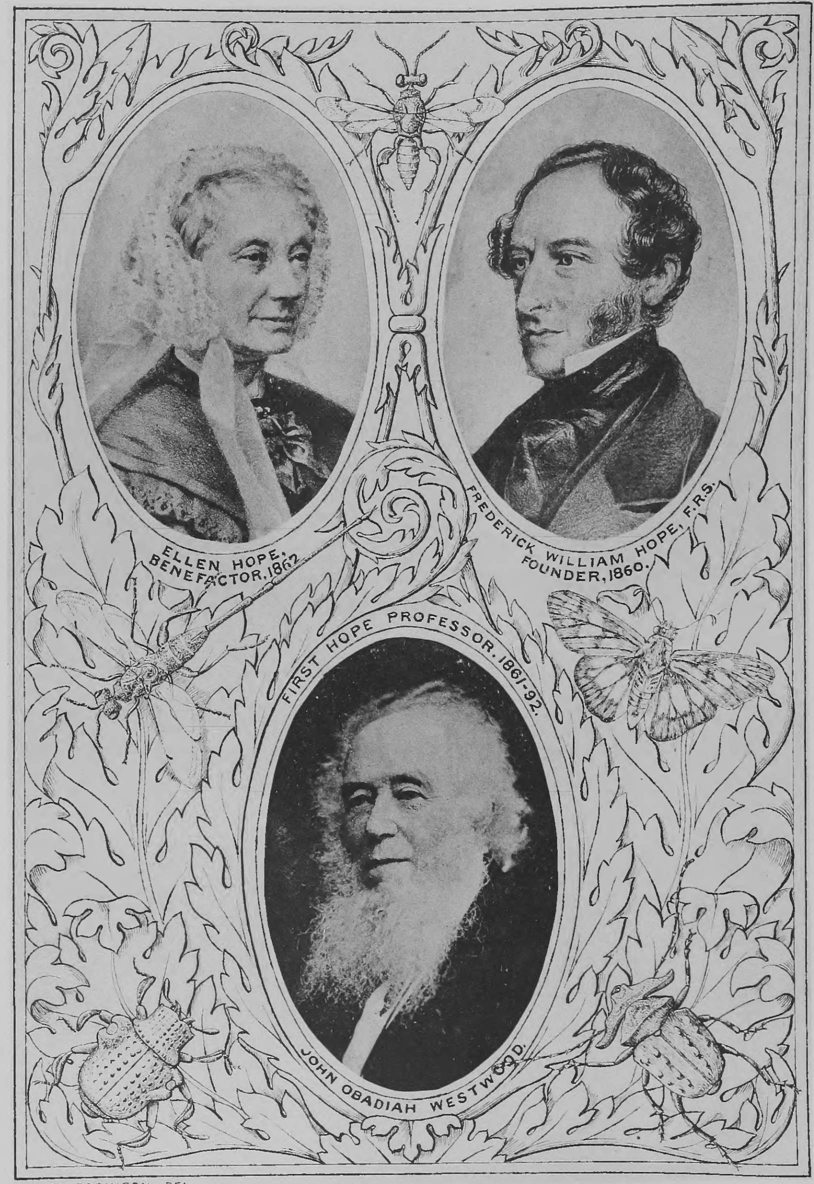
1923


ELLEN HOPE,
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FIRST HOPE PROFESSOR, 1861-92.
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THE MAKERS OF THE HOPE DEPARTMENT
OXFORD UNIVERSITY MUSEUM

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PREFACE.

THE long interval which has elapsed since the appearance of Vol. IX of these Reports has made it possible to bring together in the present volume a number of memoirs dealing with the bionomics of African insects—a convenient arrangement also previously adopted in Vols. III and IX.

Nos. 2 and 3 are important memoirs, by W. A. Lamborn and the late C. O. Farquharson respectively, devoted in chief part to the study of Lycaenid butterflies and the relationship of these and other insects to ants. No. 3 contains, on pages 325 to 335, a brief life of the author, a highly skilled and observant naturalist, whose death is a grievous loss to natural history.

Nos. 4—11 deal with mimicry in butterflies—4, 5 and 11 being short papers or brief notes by the Professor; 6—9 important and freely illustrated memoirs by Dr. G. D. H. Carpenter; of these, 8 considers, in a single species, the inheritance of small variations such as are believed to be generally necessary for the initiation of mimetic resemblance. No. 10 contains a short account of an interesting exhibit by Lord Rothschild, F.R.S. No. 11, with the record of an exhibit of African mimetic butterflies, includes a brief account of the best-known mimics in N. America, outside the scope of the present volume.

Nos. 12—15 are concerned, largely experimentally, with the relation between insects and their enemies; 12, by Dr. Carpenter, treating of specially protected, warningly coloured forms and their foes; 13, by the same author, a comprehensive series of experiments on the relative edibility of protected as contrasted with well-concealed species, also including a few important results obtained from mimetic insects; 14 and 15, by C. F. M. Swynnerton, many and varied experiments on the preferences of carnivorous insects, especially Driver Ants, and including an investigation into the palatability of butterflies' eggs, hitherto untested.

Nos. 16—19 deal with epigamic structures and functions—16 and 17, by Dr. H. Eltringham, D.Sc., describing and abundantly illustrating the scent-producing apparatus of many male Danaine butterflies, including (in 17) certain Oriental species; 18, by Dr. F. A. Dixey, the male scent-scale of a Pierine *(Pinacopteryx)*; 19, by the Professor, giving an account of W. A. Lamborn's observations on the use of the horn-like outgrowths from the mandibles of a male wasp, in its struggle with other males for the possession of the female.

EDWARD B. POULTON.

HOPE DEPARTMENT OF ZOOLOGY,
UNIVERSITY MUSEUM, OXFORD,
October 10, 1923.

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1. Preface.

2. On the Relationship between certain West African Insects, especially Ants, Lycaenidae and Homoptera, by W. A. Lamborn, M.R.C.S., L.R.C.P., F.E.S., Entomologist to the Agricultural Department of Southern Nigeria. With an Appendix containing Descriptions of New Species, etc., by G. T. Bethune-Baker, Pres. Ent. Soc., W. L. Distant, Harry Eltringham, D.Sc., M.A., Prof. E. B. Poulton, F.R.S., J. Hartley Durrant, and Prof. R. Newstead, F.R.S. With Plates XXVI.–XXIX. and Text-fig. (From "Transactions of the Entomological Society of London," 1913, p. 436.)

3. Five Years' Observations (1914–1918) on the Bionomics of Southern Nigerian Insects, chiefly Directed to the Investigation of Lycaenid Life-histories and to the Relation of Lycaenidae, Diptera, and other Insects to Ants, by the late Charles Ogilvie Farquharson, M.A., B.Sc., Aberdeen. Edited, with a Brief Life of the Author, by Edward B. Poulton, D.Sc., M.A., F.R.S., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford. With a Systematic and Descriptive Appendix by R. S. Bagnall, G. T. Bethune-Baker, Dr. T. A. Chapman, F.R.S., J. E. Collin, J. Hartley Durrant, F. W. Edwards, Dr. Harry Eltringham, D.Sc., Prof. J. Brontë Gatenby, D.Phil., D.Sc., Prof. R. Newstead, F.R.S., Prof. E. B. Poulton, Prof. F. Silvestri, Dr. J. Villeneuve, and Dr. James Waterston, B.D., D.Sc. With Plates IX.—XIX. and Text-figs. 1–6. (*Ibid.*, 1921, p. 319.)

4. Mimicry and Butterflies, a Friday Evening Discourse, Royal Institution, March 5, 1915, by the Professor. (From "Proceedings of the Royal Institution," 1915, p. 372.)

5. Mimicry between the Genera of certain African Nymphaline Butterflies, by the Professor. (From "Report, British Association," Birmingham, 1913, p. 519.)

6. Pseudacraea eurytus hobleyi, Neave, its Forms and its Models on Bugalla Island, Lake Victoria, with Other Members of the Same Combination, with Plates XXXIV.—XXXVI., by G. D. Hale Carpenter, D.M., Oxon., Member of the Royal Society's Sleeping-sickness Commission. (From "Transactions of the Entomological Society of London," 1913, p. 606.)

7. Pseudacraea boisduvali, Doubl., and its Models, with Especial Reference to Bugalla Island, with Plates XXXVII.—XXXVIII., by Dr. G. D. H. Carpenter. (*Ibid.*, 1913, p. 646.)

8. The Inheritance of Small Variations in the Pattern of Papilio dardanus, Brown, with Plates XXXIX.—XL., by Dr. G. D. H. Carpenter. (*Ibid.*, 1913., p. 656).

9. Pseudacraea eurytus hobleyi, its Forms and its Models on the Islands of Lake Victoria, and the Bearing of the Facts on the Explanation of Mimicry by Natural Selection, with Plates II.—III. and Map, by G. D. Hale Carpenter, M.B.E., D.M., etc., Uganda Medical Service. (*Ibid.* 1920, p. 84.)

10. Mimetic Species of the African Nymphaline Genus Pseudacraea and the Lycaenid Genus Mimacraea, together with their Acraeine and Danaine Models and some Co-mimics, by Lord Rothschild, Ph.D., F.R.S., F.L.S. Abstract. (From "Proceedings of the Linnean Society of London, 130th Session, Nov. 1917 to Jan. 1918, p. 10.)

11. Exhibition of a New Mimetic Form of Pseudacraea poggei from ex-German East Africa, with other African Mimics of Danaida chrysippus; also the Mimetic and Mendelian Relationships of the "White Admirals" of North America, by the Professor. Abstract. (*Ibid.*, p. 10.)

12. The Enemies of "Protected" Insects; with Special Reference to Acraea zetes, by Dr. G. D. H. Carpenter. (From "Report, British Association," Birmingham, 1913, p. 516.)

13. Experiments on the Relative Edibility of Insects, with Special Reference to their Coloration, by Dr. G. D. H. Carpenter. (From "Transactions of the Entomological Society of London," 1921, p. 1.)

14. Experiments on some Carnivorous Insects, Especially the Driver Ant Dorylus; and with Butterflies' Eggs as Prey, by C. F. M. Swynnerton, F.L.S., F.E.S. (*Ibid.*, 1915, p. 317.)

15. Further Notes on the Eggs of Butterflies, a Supplement to the above paper, No. 14, by C. F. M. Swynnerton. (*Ibid.*, 1915, p. 428.)

16. On the Scent Apparatus in the Male of Amauris niavius, Linn., with Plate XX., by Dr. H. Eltringham, D.Sc., M.A., New College, Oxford. (*Ibid.*, 1913, p. 399.)

17. Further observations on the Structure of the Scent Organs in certain Male Danaine Butterflies, with Plates XI.—XX., by Dr. H. Eltringham. (*Ibid.*, 1915, p. 152.)

18. The Scent-scale of Pinacopteryx liliana, Gr. Smith, with Plate XVI., by Dr. F. A. Dixey, M.A., D.M., F.R.S., Sub-Warden of Wadham College, Oxford. (*Ibid.*, 1919, p. 383.)

19. W. A. Lamborn's Observations on Marriage by Capture by a West African Wasp. A possible Explanation of the Great Variability of certain Secondary Sexual Characters in Males, by the Professor. (From "Report, British Association," Birmingham, 1913, p. 511.)

XX. *On the Relationship between certain West African Insects, especially Ants,* Lycaenidae *and* Homoptera. By W. A. Lamborn, M.R.C.S., L.R.C.P., F.E.S., Entomologist to the Agricultural Department of Southern Nigeria. With an Appendix containing Descriptions of New Species, etc., by G. T. Bethune-Baker, Pres. Ent. Soc., W. L. Distant, Harry Eltringham, D.Sc., M.A., Prof. E. B. Poulton, F.R.S., J. Hartley Durrant, and Prof. R. Newstead, F.R.S.

[Read June 4th, 1913.]

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INTRODUCTORY NOTE by Prof. E. B. Poulton.

THE following memoir was written by the author at various times between September 1912 and April 1913. The work was done in the Hope Department, where the specimens, which had already been mounted and labelled, were compared with the records of original observations made in Southern Nigeria. If Mr. Lamborn had not been so greatly pressed he would have entirely completed the memoir, but there was so much to be done during his last visit home that he was not able to put the finishing touches to the paper or to verify his account by a second comparison between specimens and manuscript. I have now, however, been through the whole of it and verified all the data. All additions or comments of my own, except mere verbal alterations, will be found under separate headings with my initials, or within square brackets. Many of the latter passages are also signed by my initials.

From the dates which are freely quoted in the body of the memoir it will be seen that Mr. Lamborn made his observations between September 1911 and the end of July 1912, when he sailed for England. A few earlier observations on the same subject, already published, are referred to under the respective species.

The author's collecting ground—Oni Camp, 70 miles East of Lagos—is at a low elevation, never more than 50 ft. above sea-level. The bush has been cleared in the immediate neighbourhood, but around the camp, at the time when Mr. Lamborn collected, were large tracts of primitive forest, in which, unless otherwise stated, it may be assumed that the captures were made. All precise distances such as "1 mile E.," etc., refer to localities in the forest at various distances to the East of Oni Camp.

In the laborious and minute work of preparing Mr. Lamborn's material so that this paper could be written, I have to thank my assistants in the Hope Department, Mr. A. H. Hamm and Mr. Joseph Collins. The setting, printing and labelling has involved a very large amount of labour, and the almost complete accordance between Mr. Lamborn's notes and the specimens is evidence that a successful result has been obtained.

It may be assumed that the notes in Mr. Lamborn's manuscript are confirmed by the data he had written to accompany the specimens, except in the few cases in which a discrepancy is mentioned. A careful examination of the whole of the material in the Hope Department will well repay the naturalist who is interested in ants and the insects associated with them. The related forms are kept together and arranged in the order of the present memoir to which they supply the fullest illustration. (E. B. P.)

INTRODUCTION.

The observations herein recorded were made during the latter part of a three years' sojourn in Southern Nigeria in a bush camp at Oni, situated 70 miles E. of the town of Lagos and about 10 miles from the sea.

In the course of a study directed in the first place towards an elucidation of the life-history of West African Lycaenid butterflies it was found that, as has frequently been noted in other parts of the world, a very close relationship exists between their larvae and ants.

The relationship has in the majority of cases in West Africa been found to be one tending to the common good of both, the ants lavishing their blandishments on the smooth soft-skinned larvae, and in some instances very definitely extending hospitality and protection to them in return for much-prized secretions from certain special glands, evidently very similar to those described for the first time in 1867 by Guenée as existing in certain European Lycaenid larvae, and since found in many New World and Oriental species. The character of the gland in various Ethiopian larvae will be touched on when recording observations made on particular specimens. For the present it will suffice to mention that in most cases an orifice from which a fluid secretion will exude under appropriate stimuli has been found to exist on the dorsal aspect of the 11th segment, and that behind it and to the outer side is a pair of protrusible tubercles which seem to exert a definite attractive influence on the ants.

In other cases a triple association has been found to exist between Lycaenid larvae, ants and Homoptera, in which the larvae, though treated as honoured guests by their ant hosts, repay them with the basest ingratitude by devouring their fellow-guests the Homoptera. In such instances as far as has been discovered the attraction exerted on the ants by the larvae is a much weaker one than in the preceding case, for though the accessory tubercles have been noted, no gland has as yet been seen nor have the ants been observed to concentrate their interest at the site at which the secreting structure is usually found, as in other larvae. Still further, some Lycaenid larvae are undoubtedly present as predaceous intruders on colonies of Homoptera fostered by ants and are of no benefit to them whatever though they are tolerated from necessity, because the ants are unable to put up a successful fight with an enemy protected by hairy fringes, by hard rough tubercles or a tough cuticle, though, as will be seen, they do not hesitate to avail themselves of a chance to commence an attack when a favourable opportunity presents itself.

Prof. Poulton suggested to me that in writing an account of the various species I should perhaps give the most vivid impression in my power if I transcribed the original notes written when the living insects were actually before me, with only such alterations as more recent knowledge has shown to be necessary. These notes were originally contained in letters written by me to Prof. Poulton and I have to thank him for the care with which he has preserved them so that they are now available for my present purpose, for the trouble involved in identifying some of my specimens and in getting others named by various authorities, so that on my return I found them labelled and ready for reference; but above all I wish to thank him for the constant stimulus and encouragement afforded by his interest in my work and for his ever ready help and guidance by which alone my results could have been obtained.

It is also my pleasant duty to thank Mr. G. T. Bethune-Baker, Pres. Ent. Soc., Prof. Poulton, Mr. H. Eltringham, Mr. W. L. Distant, Mr. J. Hartley Durrant, and Prof. R. Newstead, F.R.S., who have contributed valuable sections to the Appendix; and Prof. A. Forel, who has named the ants. Mr. W. C. Crawley very kindly carried this latter material safely to Switzerland and back, by hand.

The whole of the material is in the Hope Department at Oxford, and as the numbers originally attached to the specimens have been printed on the labels all can be readily identified.

A.—LIST OF 'ANTS AND INSECTS ASSOCIATED WITH THEM (E. B. P.)

I have drawn up the following analysis of the associations recorded in this memoir. The list of ants, with the exception of those marked by an asterisk, is quoted from Prof. Forel's paper, *Fourmis de Nigérie*, in Revue Zoologique Africaine, Brussels, 1913, pp. 352, 353. The species marked by an asterisk were with one exception determined by Prof. Forel, although they do not appear in his paper. The exception is *Oecophylla smaragdina*, r. *longinoda*, kindly determined by Mr. G. Meade-Waldo in the British Museum. The sign † indicates that the insects associated with the ants were also associated with each other, although the nature of the association is far from uniform. It is to be understood that the great majority of the ant-associations are with the larvae or pupae of the species named.

The ants were determined by Prof. Forel quite independently of their associations, and when his names had been affixed, and the ants re-grouped according to the Lycaenid larvae, etc., they were tending, it was seen that the species and races were remarkably constant in their respective groups. The exceptions were the two species of *Pheidole*, once mixed in the same group (pp. 467–8) almost certainly the result of an accident in labelling after the specimens had been received from Switzerland—and the two races, *alligatrix* and *winkleri*, of *Cremastogaster buchneri*, once mixed according to Prof. Forel's determinations (p. 484), once mixed, not in this but in another group, according to Mr. W. C. Crawley and Mr. A. H. Hamm (p. 484). It must be remembered, however, that *winkleri* and *alligatrix* are often very difficult to separate, and Forel himself speaks of intermediate forms. If there has been no mistake, the two forms are sometimes to be found attending the same larva, and it is difficult to believe that the races are really distinct.

Mr. W. C. Crawley has very kindly come to Oxford on purpose to verify the ants in the various groups, and has carefully examined the whole of the material. The data are so numerous and complex, and mistakes, in spite of the utmost care, so probable, that Mr. Crawley's examination of the collection has been a great satisfaction to me.

*1. ODONTOMACHUS HAEMATODES, Linn. ☿

Associated with the Lycaenid *Lycaenesthes flavomaculata* (p. 483).

2. SIMA AETHIOPS, Sm. ♀.

Associated with *Coccidae* and probably with the larva, and pupa of the Aegeriid moth *Tinthia lambornella* (p. 493).

3. CREMASTOGASTER BUCHNERI, For., r. ALLIGATRIX, For. ☿.

Associated with the following Lycaenids: *Epitola oniensis* (p. 457), *Deudorix* (*Hypokopelates*) *obscura* (p. 471), *Lycaenesthes flavomaculata* (p. 483), *Triclema lucretilis* (p. 485). With *Stictococcus sjöstedti* (p. 462), and other Coccids (p. 486). Attacking the Jassid *Nehela ornata* (p. 462).

4. CREMASTOGASTER BUCHNERI, For., r. CLARIVENTRIS, Mayr. ☿.

Associated with the Lycaenid *Lycaenesthes alberta*? (p. 476).

5. CREMASTOGASTER BUCHNERI, For. r., WINKLERI, For. ☿.

At first Prof. Forel was inclined to consider this form as a variety of *africana*, Mayr, another race of *buchneri*, but more extended study has led him to give it the position of a separate race.

Associated with the Lycaenids *Aslauga lamborni* † and the Coccid *Stictococcus sjöstedti* (p. 447); with *Lycaenesthes flavomaculata* (p. 483), *Triclema lucretilis* (p. 485).

6. CREMASTOGASTER BUCHNERI, For., r. LAURENTI, For. ☿.

Associated with the Lycaenid *Aslauga vininga* † and the Coccids *Dactylopius longispinus* and *Lecanium punctuliferum*, var. *lamborni* (p. 446).

In addition to the above races, *Cremastogaster buchneri*, For., ? race, is described as associated with the following *Lycaenidae*:—probably *Epitola ceraunia* (p. 456), *E. carcina* (p. 456), *Argiolaus alcibiades* (p. 474), *A. julus* (p. 474).

7. PHEIDOLE ROTUNDATA, For., var. ☿.

This form appears in Prof. Forel's paper under the name *Pheidole punctulata*, Mayr., r. *impressifrons*, Wasm. Prof. Forel, however, informs me that the ant is, in his opinion, even closer to *P. rotundata*, For. r., *ilgii*. For., than it is to *P. punctulata*. He considers it to be intermediate between *punctulata* and *rotundata* but nearer to the latter. This is the principal "house-ant" of Oni, although it is also found in the open. Throughout the following paper it will be described as *P. rotundata*, var., the name attached to the specimens by Prof. Forel.

Associated with the following Lycaenids after they had been brought home, nearly always replacing ants of other species removed at time of capture: *Aslauga lamborni* † and *Stictococcus sjöstedti* (p. 447); with *Myrina subornata* (p. 472), *Hypolycaena philippus* (p. 474), *Lycaenesthes lachares* (p. 478), *L. flavomaculata* (p. 483), *Triclema lucretilis* (p. 485), *Catochrysops malathana* (p. 488), *Oboronia punctata* (p. 489).

Associated with the following Lycaenids in the forest and clearing: *Hypolycaena philippus* (p. 474), *Lycaenesthes lachares* (p. 478), *N. lyzanius* (p. 484), *Oboronia punctata* (p. 489); probably with the Pyralid moth *Obtusipalpalis saltusalis* (p. 492). With the Membracid *Leptocentrus altifrons* (p. 495).

Attacking and uncertain treatment of the Lycaenid *Megalopalpus zymna* (pp. 463–4). Carrying off eggs of *Charaxes ussheri* (p. 467). Devouring sugar and dead insects in the house (p. 491). Attacking and carrying off larvae and imagines of the smaller "red house-ant" *Monomorium pharaonis*, L. (p. 491).

8. PHEIDOLE AURIVILLII, Mayr., r. KASAIENSIS, For., ☿.

Associated with the Lycaenid *Megalopalpus zymna* † the Jassid *Nehela ornata* and the Membracids *Gargara variegata*, *Anchon relatum*, *Beninia* sp., *Leptocentrus altifrons*, etc. (pp. 458–468); with *Hypolycaena nigra* (p. 473), *H. lebona* (p. 473), probably *H. philippus* (p. 474), probably *Lycaenesthes silvanus* (p. 476), *L. larydas* (p. 477), *L. lachares* (p. 478), *Oboronia punctata* (p. 489). Probably with the Pyralid moth *Obtusipalpalis saltusalis* (p. 492). With the Coccid *Stictococcus sjöstedti* (p. 460). With the Membracid *Anchon decoratum* (p. 498).

*9. OECOPHYLLA SMARAGDINA, F., r. LONGINODA, Latr., ☿.

Associated with the Coccid *Stictococcus sjöstedti* (p. 447, 453), the Lycaenid *Euliphyra mirifica* (p. 450), a Heterocerous larva (p. 451), *Aphidae* (p. 453), with the Noctuid *Eublemma ochrochroa* † and *Stictococcus* (p. 491).

Carrying off just hatched larvae of the Saturniid moth *Bunaea alcinöe* (p. 467).

*10. CAMPONOTUS MACULATUS, F., subsp. ? ☿

Associated with the Lycaenids *Myrina silenus* (p. 472), and *Hypolycaena philippus* (p. 474), the latter as an exception. With the Psyllid *Rhinopsylla lamborni* (p. 498).

CAMPONOTUS AKWAPIMENSIS, Mayr., var. POULTONI, For., ☿.

The sign ♀ has been inadvertently printed instead of ☿ in Prof. Forel's paper (*l. c.* p. 353).

Associated with the following Lycaenids: *Lachnocnema bibulus* † and the Jassid *Ossana bicolor* (p. 470); with *Myrina silenus* (p. 472), *Hypolycaena philippus* (p. 474), *Lycaenesthes silvanus* (p. 476), *L. larydas* (p. 477), *Catochrysops malathana* (p. 488). In shelters with Membracids and Jassids (p. 465). With *Nehela ornata* (p. 465). With the Membracids *Leptocentrus altifrons* (p. 495, 497), and *Neoxiphistes lagosensis* (p. 497).

B.—LYCAENIDAE ASSOCIATED WITH ANTS: INTRODUCTORY NOTE (E. B. P.)

The following 27 species of *Lycaenidae*, with the exception of the *Lycaenesthes* group, are arranged in the order of Aurivillius' "Rhopalocera Aethiopica" (1898). In *Lycaenesthes* and its allies I have followed Mr. Bethune-Baker's monograph (Trans. Ent. Soc., 1910, p. 1).

Mr. Bethune-Baker's description of new forms of

Lycaenidae, in the Appendix to the present memoir (p. 499), includes a species of *Aslauga* upon which no bionomic observations have been made by Mr. Lamborn. It was thought, however, that it would be convenient for an account of this novel and interesting form to appear beside that of allied species whose bionomic associations are here recorded.

Emergence of the sexes.—Mr. Lamborn's careful records throw much light upon the question of the relative order of the emergence of the sexes of butterflies, and, in the present paper, some of his facts are now made public. It will be observed that in most *Lycaenidae*, of which a sufficient number were bred from the same family, the females emerged on the average before the males—a result opposed to the usual experience in butterflies. In *Euliphyra mirifica*, however, 3 males emerged before any of the 5 females (p. 455–6). The other species, in which marked results were obtained, are *Epitola ceraunia*, 9 females, 6 males, and 1 male and 1 female together, emerging in that order, Feb. 22–23, 1912 (p. 456); *Hypolycaena nigra*, 5 females, 1 male and 1 female together, 2 females, all within 24 hours, Feb. 13–14, 1912 (p. 473); *Lycaenesthes lachares*, the groups tabulated on p. 481, where the early emergence of females is very clear; *L. flavomaculata*, 1 female, 2 males, Jan. 19–20, 1912 (p. 483).

The notes also show that emergence of certain species takes place at a particular time of the day, and indicate furthermore the interval between emergence from the pupa and the first flight. This period is seen to be very short in Lycaenid butterflies, contrasting in the most remarkable manner with the facts observed by Mr. Lamborn in the specially protected *Acraeinae*.

Relationship with ants.—The relationship with the ants will be found to be extremely varied, some species, such as *Lycaenesthes flavomaculata* (p. 483), being associated with various kinds of ants, others again being confined to a single species. The number of observations upon the replacement of the ants found attending the larvae in the wild state by the "house-ant" *Pheidole rotundata*, var., are of the highest interest.

It will be noted that the behaviour of certain ants towards certain Lycaenid larvae is marked by much uncertainty, *e. g.* in *Euliphyra* and *Megalopalpus* (pp. 453, 463–4).

A puzzling and difficult problem is presented by *Euliphyra*, shown by Mr. Eltringham's paper in the Appendix (p. 510) and by Mr. Lamborn's observations (pp. 452–3) to be effectively protected against ants and to be attacked by them under certain circumstances (p. 453), and yet thrusting its head and neck into the mouth of an ant in order to be fed (p. 452). In such cases the most helpful consideration is probably that suggested in conversation to the present writer by Prof. W. M. Wheeler, viz. that the ant community is so successful and affords so safe a retreat from the attacks of enemies, that ants are liable to be overwhelmed by the numbers of forms living under their protection. The uncertainty of their temper is probably one means by which this danger is prevented from becoming too great; for a species that seeks the shelter of the ants' nest is itself taking terrible risks.

The species of *Lycaenidae* observed by Mr. Lamborn belong to both subfamilies *Lipteninae* and *Lycaeninae*. The *Lipteninae*, which will be described first, are included in the genera *Aslauga*, *Euliphyra* and *Epitola*.

In this and all the following sections of the present paper, when there is no further specification, it is to be understood that the ants referred to belong to the worker minor caste.

I. LIPTENINAE.

1. *Aslauga vininga*, Hew.

A. marginata, Plötz, 1888, is evidently the female of this species (see p. 499).

The associated ant was *Cremastogaster buchneri* r. *laurenti*.

No. 695. The following note referring to this ♀ specimen was written March 24, 1912 :—

" The larva of this Lycaenid was carnivorous, its prey being Coccids such as are now sent. These insects occur in great numbers at the base of some leaves on the underside, filling up the depressions between the main ribs and clustering also on the stem just below the insertion of the petioles. They are attended by ants which frequently construct shelters over them."

The larva was found in the forest 1½ miles E. of Oni, Feb. 25; pupation, March 3; emergence, March 14.

The Coccids have been determined as *Dactylopius* *longispinus,* Targ.-Tozz. (p. 523), and 12 ants were in attendance.

No. 699. A ♂ specimen is referred to in the following note dated March 24, 1912 :—

"The larva of this Lycaenid was carnivorous and ate tiny smooth hemispherical insects attached in colonies to the stems of various plants, especially kola. These insects are also attended by ants which cover them with shelters." Parts of two shelters are in the collection and the material of which they are built is described on p. 524 by Prof. R. Newstead. The larva was found in the forest 1½ miles E., Feb. 25; pupation, March 2; emergence, March 17.

The food-insects referred to are Coccids—a new form—which has been named *Lecanium punctuliferum,* var. *lamborni,* Newstead (p. 523), and the 19 ants found ministering to them are the same as in No. 695, viz. *C. buchneri laurenti.*

2. *Aslauga lamborni,* Bethune-Baker, sp. n. (p. 499).

The associated ant was *Cremastogaster buchneri* r. *winkleri.* In the house, *Pheidole rotundata,* var., was attracted to the larva or to the Coccids.

No. 543. The larva from which this male specimen was bred, Nov. 22, 1911, was obtained in the forest 1½ miles E. on Nov. 1, and it pupated Nov. 3. [The specimen is the male type of the species.]

A note dated Nov. 27, 1911, referring to it, is as follows :—

"The stem of the plant, *Bridelia micrantha,* Baill. (*Euphorbiaceae*), on which the larva was found, bore a number of *Coccidae* [*Stictococcus sjöstedti,* Cockerell] which are almost invariably attended by ants. They often roof over a number of the Coccids with a thin covering composed of particles of bark and other vegetable débris so as to form a convex chamber which fits down on all sides round the enclosed insects. The chambers are about the size and shape of a half hazel-nut, and they are tenanted by ants as well as Coccids."

"Dec. 4, 1911. I am disposed to think that in some cases *Lycaenidae* find food where these bodies have been; for some stems frequented by the butterflies look as if they had borne the Coccids. The *Stictococci* are usually surrounded by a multitude of ants, and I was interested to see that the ferocious 'tree-drivers' (*Oecophylla*) do not eat them but seem, like other ants, to visit them for some food-material."

The note dated Nov. 27, 1911, continues, speaking of the larva of *A. lamborni* :—

"The larva, brown in colour and resting motionless on the stem, looked so very like one of these ant-constructed chambers that it had a narrow escape from injury, for I actually attacked it with scissors under a mistaken impression as to what it really was, my custom being invariably to explore these chambers. I did not actually discover what its food was, for it pupated almost immediately."

The Homoptera have been determined by Prof. Newstead as a species of Coccid—*Stictococcus sjöstedti*, Cockerell (p. 521), of which 4 were borne by a stem of *Bridelia* sent with the specimens. The stem also showed distinct marks where other Coccids had been fixed to it. Two *C. buchneri winkleri* accompanying the specimens, were probably collected with the Lycaenid larva on Nov. 1.

No. 591. One male labelled B and a female labelled A. The text of a note dated Jan. 13, 1912, relating to these specimens, is as follows :—

"I discovered yesterday, in the forest 1½ miles E., two carnivorous larvae, the food of which is the little beady insects found in considerable numbers, immobile and firmly fixed to the young shoots of certain plants."

The Lycaenid larvae, when found Jan. 12, were resting on plant stems, 2 of which are in the collection, and they bear many Coccids identified by Prof. R. Newstead, F.R.S., as *Stictococcus sjöstedti*, Cockerell (p. 521). Twenty-four ants, *C. buchneri winkleri*, attending the Coccid food-insects near to the larvae, were sent, together with 77 others visiting the Coccids or elsewhere on the plant.

The larva of B ceased feeding and became motionless Jan. 17, and both larvae pupated Jan. 19; A emerged Feb. 3, B Feb. 4.

My note goes on : "The two larvae were attended by ants [since determined as *C. buchneri winkleri*], and on the same stem were five Coccids which yield a watery secretion much in demand by ants. The leaves on the stem were snipped off and it was then carefully transferred to a glass tube so that none of the insects were disturbed. On arrival home it was found that 3 only out of the 5 Coccids remained. The ants were taken away and the larvae transferred, at 5 p.m. Jan. 13, to a tube containing a stem bearing 22 Coccids. In a short time tiny black ants (identified as *Pheidole rotundata*, var.), which abounded in the house, found their way into the tube, which was then closed with very fine gauze and put away on a shelf, out of reach, it was thought, of more ants. However, more of the same species found it during the night and being unable to get in collected in a little knot on the gauze.

"When the tube was inspected at 8 a.m. on the following day, 14 of the Coccids had disappeared—most of them entirely. The rings which had formed the basal portion of the scale of a few Coccids were, however, left by the caterpillars.

"Later in the day I actually watched with a lens one of the larvae eating a Coccid, and at 1 p.m. only 3 Coccids out of the 22 remained. The larvae passed frass abundantly. The ants took no part in eating the Coccids."

A note dated Jan. 15, 1912, is as follows:—

"At 5 p.m., Jan. 14, 1912, the 2 larvae were placed in separate boxes and all ants excluded for 24 hours. By 5 p.m. on the following day A had consumed 12 out of the 15 Coccids that I had placed at its disposal, and larva B had taken 16 out of 28, a few basal portions still remaining attached to the stems supplied to both larvae. I found that the larvae would eat these Coccids whatever the plant they happened to be attached to. The secretion of the Coccids was not sweet to the taste, but had an aromatic flavour rather suggestive of turpentine.

"These larvae presented the same general characteristics ar those of *A. vininga*, being oblong on dorsal view with lateral surfaces sloping downwards and outwards. They had a hard tough toad-coloured skin covered with coarse rough tubercles, evidently protective in function, and it extended down as a fold on all sides in carapace fashion so as to protect the softer lateral and ventral surfaces. The lower margin of this fold bore a fringe of very fine hairs such as would efficiently prevent small insects from crawling in underneath. The segmentation characteristic of Lepidopterous larvae was shown only by the presence of spiracles, but rather more than halfway to the anal extremity was a deep transverse groove, the only region at which, owing to the leathery consistence of the cuticle, it was possible for flexion to take place. The cuticle was indeed so hard that a larva placed on its back was unable to bend itself sufficiently to turn over unaided. Towards the hinder end of the body and just inside the spiracular line were two horny rounded eminences, one on each side of the mid-dorsal line. From these eminences pointed tubercles were from time to time thrust out, but no dorsal gland was detected. The tubercles appear to represent those of the *Lycaeninae*, in which group, however, they are more externally placed, being just to the outer side of and behind the spiracles of the 12th segment (see p. 488–9).

"The head was small in proportion to the size of the larva and there was a definite neck, of sufficient length to enable the head to be thrust forward or retracted in tortoise-like manner under the shelter of the carapace. The anus was protected in a similar manner. I have witnessed the protective value of the carapace in a larva of this type as described on p. 452."

No. 526. Male. The pupa of this was found in the forest 1½ miles E., on a leaf of the plant *Culcasia scandens* on Oct. 22, 1911, near black ants of the genus *Cremastogaster*. Emergence, Nov. 5.

No. 658. Female. The larva found in the forest 1½ miles E., on Jan. 26, 1912, fed up, in five days' time, on *Stictococci* which were attended by the same ants as No. 591, etc., viz. *C. buchneri winkleri*. It is especially noted of 24 of these ants that they were not only attending the *Coccidae*, but also running over the Lycaenid larva.

Pupation, Jan. 31; emergence, Feb. 14.

No. 688. Female. The larva, found in the forest 1½ miles E., on Feb. 16, 1912, fed up on the same Coccids, and pupated on Feb. 21, emerging March 6.

No. 819. Female. The larva was found in the forest 1½ miles E., on June 5, 1912, and having fed up on the Coccids, pupated on June 8, emerging June 24.

3. *Euliphyra mirifica*, Holland.

[A brief revision of the genus based on Mr. W. A. Lamborn's material will be found on pp. 504–8. Mr. Eltringham's account of the larva will be found on p. 509.]

The associated ant was *Oecophylla smaragdina* r. *longinoda*.

A preliminary note as to the presence of Lycaenid larvae and pupae in the nests of *Oecophylla* was communicated to the Entomological Society on March 20, 1912, by Prof. Poulton (Proceedings, pp. xxxii, xxxiii), and, on Nov. 6, I was able to exhibit to the Society (*ibid.*, p. cvi) two larvae in spirit and two bred imagines with the corresponding pupa-cases. Seven butterflies in all were bred out. The larvae, which approximate to the type described in *Aslauga*, seem to be very near to that of *Liphyra brassolis*, Westw., described by Bingham in his "Fauna of British India," to which account my attention was drawn by Mr. A. H. Hamm, of the Hope Department. This larva is found in the East and in Australia in the nests of *Oecophylla smaragdina*. It is apparently present as an intruder, and the suggestion has been made that it feeds on the immature forms of ants. Though I have paid especial attention to this point I have not found such habits in *Euliphyra*. Furthermore, the pupa is not protected by the hard chitinous larval skin described in *Liphyra*, although the skin of *Euliphyra* is tough and heavy-looking and still partially encloses the posterior segments of 3 out of 8 pupae, viz. E, F and G (see p. 455–6).

The following notes, contained in a letter dated Feb. 10, 1912, refer to the larvae of *Euliphyra* :—

"In accordance with your request I commenced an investigation as to whether our form of *Oecophylla* does make use of its larva to weave together the leaves composing the nest. I opened up some nests a few weeks ago, but the ants were so deliberate in their movements that I had to defer the necessary watching till I could spare more time.

"On Feb. 6 I made a window into a nest, snipping out a square piece of leaf with scissors, and on looking in I saw a larva which I recognised at once, as it was similar to the one which I saw assailed by these ants, but successfully protected itself against attack by drawing down its hard carapace-like shield in limpet fashion, to the supporting surface. I tore the nest open and discovered more larvae and thereupon took ants and all in a tin box. I broke other nests open and found larvae in four more, bringing up the total of larvae secured to 19. They were not all of the same age in each nest.

"In one nest, not containing these larvae, I found a totally different caterpillar—rather hairy and evidently Heterocerous. The hairs were very stout and curved back over each segment, obviously as a protection. I did not discover what it ate, and it soon formed a cocoon of stout silk inside a web of finer material. Last night, however, some creature, probably a rat, broke into the box and ate it, together with a fine *Charaxes* pupa.

"I think that the 19 larvae must be Lycaenid! I will not attempt to describe them in detail as I am sending some in spirit. They are protected by a hard, leathery skin. The head is remarkable. When the larva is at rest, and usually when it crawls, the head is completely hidden by a fold of skin which extends all round so as to form, with the leathery skin of the dorsum and sides, a kind of carapace. The head is sometimes thrust forward under the fore margin of this fold and one then sees quite a long neck gradually tapering up to a point terminated by fine jaws. [For this and other details of the larval structure see Plate XXVIII and Mr. Eltringham's account, pp. 509–12.] The larva, as it crawls, frequently swings this proboscis first to one side and then to the other as if in search of food. It took me 48 hours to find out the source of their food-supply; for they did not touch the leaves, and I did not see them attack ants or ant larvae, neither did they go near the dead insects which the ants had stored as food.

"By this time the ants had to some extent settled down in glass-fronted boxes and I saw large workers feeding smaller ones, the two standing opposite to each other, the smaller with head a little bent back. I fancy that the larger ants must have been disgorging food into the mouths of the smaller ones. Anyhow I actually saw a Lepidopterous larva thrust its little proboscis into the jaws of a large ant and keep it there while the ant made movements as if feeding it. Sometimes too, when a large ant was feeding a smaller one, the latter retired in favour of a caterpillar.

"The caterpillars were frequently near with extended proboscis when the ants were ministering to their own male and female larvae.

"The feeding does not seem to take place very often: I presume that the high nutritive value of the material provided makes it unnecessary."

"Feb. 10, 1912. The larvae in the nests of *Oecophylla* have neither dorsal gland nor tubercles. I have not discovered how they can benefit the ants."

"Feb. 18, 1912. I replaced yesterday in the nests of *Oecophylla smaragdina* the rest of the larvae originally found; for the ants were not doing well. All the winged forms and some ant larvae had been dead for some days and the workers seemed sickly. I think it is noteworthy that the larvae had all been on one leaf since my last note and that this had not been eaten at all; also that, though the ant larvae were dead and had dropped down—the last one four days ago—yet the Lepidopterous larvae were all alive and had even grown a little. The ants certainly seem to feed them.

"I find that if a worker comes across water it drinks, and then proceeds to disgorge it for the benefit of any one of its thirsty fellows that it may meet, and I think the same thing happens in the case of food. *Oecophylla* attends *Aphidae* and is also very fond of the secretion of *Stictococcus sjöstedti.*"

"March 29, 1912. I have hitherto failed to breed the Lycaenid larvae which live in the nests of *Oecophylla.* They appear to be extremely slow-growing. I am still watching the larvae, but observation is attended with difficulty, because the ants desert if one interferes too much, and it is necessary to break open the nest each time one wishes to inspect the larvae. The head and neck of the larvae appear to be protected against attack, but the ants lose no opportunity of seizing other parts. I once saw a larva crawling with an ant fastened on to one of its claspers, the abdomen only of the ant being visible, as the rest of its body was under the lateral fold of skin. I have also seen a larva which protected itself by just settling down closely on the supporting surface, and when the ants retired it raised itself a little and crawled, but when they reappeared settled down again."

[F. P. Dodd—in his paper in "Entomologist," 1902, p. 184—describes a similar attack by *Oecophylla* and defence by the larva of *Liphyra brassolis.*]

"May 13, 1912. I continue to watch the larvae in the nests of *Oecophylla.* They have grown considerably, but I have not been able to find pupae as yet. One has to be careful not to disturb the ants very frequently or they desert the nest."

"June 10, 1912. You will have been expecting news as to the larvae which live in the nests of *Oecophylla.* I have a pupa at last. I have examined the nests about every fortnight, but my interference has caused the ants to remove to a new home nearly every time, and, as the larvae have been obliged to wander till they found the nest, I presume that some have been lost. To this I attribute the gradual dwindling in their numbers. I have found the larvae a little larger each time I have inspected them, and to-night I found a fresh pupa with the cuticle of the larva still adherent to its base.

"Presuming that these larvae are the same that I restored to ants' nests weeks ago—and I think they are—they have taken far longer to attain full growth than in my experience is usual with Lycaenid larvae.

"I have examined a great number of nests of *Oecophylla* without finding more of these or any other larvae, and I frequently looked into nests last year and during my first year on the West Coast, for the purpose of watching the ants, and I did not find larvae, so that I am not disposed to accept the statement that Lepidopterous larvae are very commonly found in the nests of these ants in this country. I am inclined to think that one would find a greater variety in the nests of the black tree-ants (*Cremastogaster buchneri*), for I have now frequently seen Lycaenids ovipositing on the bark of trees frequented by these ants, and more than once in the actual stream of ants going up and down the trunk. I have also frequently found Lycaenid pupae and pupa-cases in the immediate vicinity of their black carton nests (pp. 456–7).

"I really must try and look through some of these nests. The difficulty is that they are so hard that one would require a hammer and chisel to make any impression on them, and the ants are excessively numerous and bite savagely.

"By the way, the Lycaenid larvae were mostly in one large nest of *Oecophylla*, and I subsequently collected a few in little outlying dependencies of the same nest. Should the butterfly turn out to be one of the rarer species, surely it would be an argument against their common occurrence in nests, for, in such a position, the mortality should not be high."

"June 24, 1912. I am sending the first of the *Oecophylla* Lycaenids. Some of the other pupae do not look very healthy, but I am sure to get a few more imagines. I forget if I mentioned that I had found one small pale green Lycaenid larva of the same type as these others in a nest of *Oecophylla*. I have since found 3 other larvae of some kind, so small that I am not even able to pronounce whether they are Lepidopterous or not. They are pale green in colour, so that I am not confusing them with the larvae of ants, but the ants look after them with an assiduity as great as if they were their own offspring. When I looked into the nest the ants picked them up and carried them away, and one ant carried one of these in addition to a larva of its own species. I have made no further discoveries as to how the Lycaenid larvae feed."

"June 29, 1912. More *Oecophylla* Lycaenids are sent and cuticles accompany some of the pupa-cases. One cuticle in particular shows remarkably well the length of the neck of the larva."

"Feb. 10, 1912. The Lepidopterous larvae are not always well treated by the ants. It so happened that I accidentally put some into a box in a crevice of which there was some scale naphthalene. Some died and the others which revived were put into an ants' nest in a half-stupefied condition. Such as happened to fall on their backs were immediately seized by the ants. I also found that a healthy larva placed on its back has difficulty in turning over, and is in this position liable to attack. In one instance I saw a larva with an ant gripping it by the neck on the ventral side.

"When the larva feeds, the fore part of the body is raised and the margins of the lateral folds of cuticle are bent round till they meet, thus protecting the soft ventral surface. The head comes out at the apex of the cone thus formed."

The dates of emergence, etc., in 1912 of the 3 males and 5 females (818 A—H) of *Euliphyra mirifica* are as follows. All except one are figured on Plate XXVII.

818 A (Plate XXVII, fig. 5). Male: emerged June 20, 1912, from a pupa found earlier in the same month. The precise pupa-case accompanies this specimen as in each of the others.

B. Male (fig. 6) emerged June 28, from a pupa found in an *Oecophylla* nest in the forest, near Oni Clearing, June 11. Accompanying it is a dead pupa found attached to a leaf in the same nest.

C. Male (fig. 7): emerged June 29, from a freshly formed pupa found under the same conditions as B, on June 10.

D. Female (fig. 8): emerged July 1. Resting larva found in ants' nest June 11, pupation June 12. (Pupa-case, fig. 8A.)

E. Female (fig. 11): emerged July 2. Larva found in ants' nest June 11, pupation June 14.

F. Female (fig. 10): data as in E, save that the larva, found June 11, was in the resting state. (Pupa-case, fig. 10 A.)

G. Female: data as in F, save that pupation occurred June 13.

H. Female (fig. 9): emerged July 7, from a pupa found in ants' nest June 20. A dead pupa was also found in the same nest.

4. *Epitola ceraunia*, Hew.

The associated ant was probably a race of *Cremastogaster buchneri*.

No. 671. No less than 17 pupae were found at one spot 1½ miles E., on Feb. 17, 1912. There were no ants in attendance, but *C. buchneri* abounded in the vicinity and were to be found on the shrubs bearing the pupae.

The pupae are very like those of *E. hewitsoni*, Mab., and are fixed like the latter so that they stand on their tails. "All except one rested at an angle of 45° on their tails, and usually on the upper side of a leaf. One [N] was suspended head down under a leaf."

[All the pupae are labelled so as to bring them into relationship with the respective imagines, and all are attached to the upper surface of a leaf, except N and Q, fixed to the under surface, and C, to a stem.]

The dates of emergence are as follows: 2.15 p.m., Feb. 22, 7 females A—G; 3 p.m., Feb. 22, 1 female H; about 3 p.m., Feb. 22, 1 female I; 11 a.m., Feb. 23, 2 males J, K; about 11 a.m., Feb. 23, 4 males L—O; about 12 p.m., Feb. 23, 1 male P and 1 female Q. It is obvious that the individuals belonged to the same company of gregarious or semigregarious larvae. The relative order of emergence of the two sexes is interesting and unusual.

5. *Epitola carcina*, Hew.

The associated ant was a race of *Cremastogaster buchneri*.

No. 652. This male butterfly was bred out, 8 a.m., Feb. 8, 1912, from a pupa, and was flying about 9.30 a.m. My note of Feb. 10 records that the pupa was found Feb. 7 on a leaf within a foot of a huge nest of black ants in the forest 1½ miles E. These ants were undoubtedly a race of *Cremastogaster buchneri*, but I omitted to collect specimens. An empty pupa-case of the same species was also found on a leaf near by.

6. *Epitola oniensis*, Bethune-Baker, sp. n. (p. 501).

The associated ant was *Cremastogaster buchneri* r. *alligatrix*.

No. 635, A, B. These 2 male butterflies were bred from pupae. Emergence of A, 9 a.m., Feb 4, as it was being carried home; B, flying by 10 a.m., Feb. 6. My note concerning them is as follows :—

"Feb. 5, 1912. The two pupae were found Feb. 4, in a dead curled-up leaf of the ivy-like *Culcasia scandens*, climbing up a Kola tree in the forest 1 mile E. In a fork of the tree, and two feet above the pupae was a large carton nest of black ants [*Crem. buchneri alligatrix*, of which 35 were sent] which were running about in all directions, some being actually on the leaf bearing the pupae, a fact which strongly suggests the existence of a special association between them and the Lycaenid.

"I noted these Lycaenid butterflies in the vicinity of the same tree last year as well as this, and have often looked for larvae without success. There seems to me to be a very strong probability that the larvae have some relationship with the ants, but I did not find it feasible to break open the nest because it was very large and hard, and the ants, which were extremely numerous, bite very fiercely."

At a later date, Feb. 12, an empty pupa-case of the same species was found at the same place, also very close to the nest of ants.

Although the male of this species closely resembles that of *E. carcina*, their pupae are easily distinguished by the size and form of the dark markings on the dorsal surface.

II. Lycaeninae: introductory note.

Before describing the observations upon the separate species it is convenient to record a few general notes made upon the ant-attracting gland and paired accessory structures of the Lycaenine larva. The notes, dated Jan. 13, 1912, were drawn up after an experience of about five or six species :—

"The median dorsal opening of the gland on the 11th segment of the Lycaenine larva, has in some species well-defined anterior and posterior lips, and I have been able to induce a larva to extrude a droplet of fluid by tickling it with a wisp of wool. In some species the 11th segment is widened anteriorly opposite the mouth of the gland, and in some the opening is placed on a specially pigmented area. It is, however, possible, by careful examination, to detect the opening when there is no special pigmentation to indicate the site. In one case a pellet of excrement which accidentally fell upon the back of a larva deprived of ants, became firmly glued to the gland-opening. The secretion of another larva, also deprived of ants, had in 24 hours dried so as to form a little white crust over the orifice. Again, in a larva that had died, mould was growing at the orifice in about 12 hours, although not elsewhere.

"The ants certainly get nothing from the two accessory tubercles, and are never even permitted to touch them [see pp. 488–9], so that the only explanation I can think of is that they produce scent which attracts to the neighbourhood of the gland. There can be no doubt about the conclusion that the tubercles of some Lycaenid larvae do actually attract ants and keep them in attendance."

We now proceed to the observations upon various species of *Lycaeninae*.

7. *Megalopalpus zymna*, D. & H.

The associated ant was *Pheidole aurivillii* r. *kasaiensis*. The larvae were sometimes attacked by *Ph. rotundata*, var. These latter, in the house, were apparently sometimes hostile, sometimes peaceful.

The larvae, as will be seen by the following notes, are carnivorous, and feed on a variety of Homoptera belonging to the families *Jassidae* and *Membracidae*, which are invariably ant-attended.

I have not found that the ants derive any benefit from the presence of this larva, or that they are of service to it. There is, on the contrary, some evidence to show that their attitude to it is distinctly one of hostility, in connexion with which it is noteworthy that the larva is not of the smooth, soft onisciform type, characteristic of the *Lycaeninae*, but it is protected by a hard skin studded with tubercles which are surmounted by coarse sparse hairs.

The larva is dark-brown, a tint approximating very closely to the colour of the débris out of which the ant-shelters are constructed, a strong contrast again to the colour of the Lycaenine vegetable feeders, of which the great majority discovered were leaf-green. As with the vegetable-eating larvae, the food of *Megalopalpus* seems to range within certain limits, but though larvae have been found eating both Jassids and Membracids, a larva accustomed to take Jassids will refuse Membracids and *vice versa*, and there is some evidence that a larva which habitually eats one form of Membracid will refuse a closely-allied species.

The mother butterfly, in depositing her egg, which is a very characteristic one, exercises the same care in ensuring an immediate food-supply for the newly-hatched larva as do other butterflies for their plant-eating offspring. She places it very commonly in the immediate neighbourhood of an ant-shelter containing Homoptera, and an egg-shell is sometimes found attached to a stem actually within a shelter, having obviously been deposited before the Homoptera attracted the attention of ants, and, indeed, probably on the egg-mass itself, before hatching, since the Membracid and Jassid colonies seem to remain and feed close to the spot where the parent laid her eggs. The eggs of *Megalopalpus* have been found attached to the egg-mass of the Homoptera, and in two cases actually on living and half-grown Membracid nymphs (p. 466).

Not only does *Megalopalpus* feed in the larval state on the Homoptera, but the butterfly seems frequently to flourish also at their expense, probing them with its proboscis and obtaining food-material direct from their surface, as well as from the plant on which they happen to be resting. [It will be seen on pp. 467, 468, that this habit is as characteristic of males as females, and cannot therefore be interpreted as bearing relation to oviposition.]

The following material forms the subject of the succeeding notes, dated Jan. 18–22, 1912.

No. 603 A. ♂. Larva in forest $1\frac{1}{2}$ miles E., Jan. 14, 1912; pupation, 3–5 p.m., Jan. 20; emergence, 6.30 a.m., Feb. 1.

No. 603 B. ♀. Larva in forest $1\frac{1}{2}$ miles E., Jan. 16, 1912; pupation, Jan. 22; emergence, 9 a.m., Feb. 4. The 3 *P. aurivillii kasaiensis* sent were running over the larva of 603 B.

Seven mature Jassids, *Nehela ornata*, and 10 immature forms of the same species are labelled as the food-insects of 603. One mature *Nehela*, together with the nymph-case from which it emerged about Jan. 17, is also present. All from the forest near Oni Clearing, about Jan. 17.

"Jan. 18, 1912. In the course of a further search for Lycaenid larvae I have obtained two of the same species which are carnivorous and prey on active jumping Homoptera, which they lull to a false sense of security by simulating the attentions of ants. The history of my discovery is as follows. On Jan. 14 I found, on a young leaf of the plant *Musanga smithii*, R.Br. (*Urticaceae*), a small Lycaenid larva brown in colour and studded all over with tubercles. A number of the small black ants, since determined as *Pheidole aurivillii* r. *kasaiensis*, were running about over the leaf, on the underside and margins of which they had built up shelters of waste vegetable matter, such as they construct so frequently over *Stictococcus sjöstedti* and other Coccids.

"On cutting off the leaf with a view to making a closer examination, I shook it, with the result that several tiny insects, since described as the Jassid *Nehela ornata*, Dist. (see p. 519), left the shelters and jumped to a distance in all directions. I did not at the time attach any definite significance to the presence of these insects; but the larva would not feed in captivity. I offered it a fresh branch of the plant on which it had been, and when it refused this I tried it with maimed ants, *Aphidae*, *Stictococci*, and the larvae of *Membracidae*, for I could not find any more of the Jassids near which it had been discovered. On Jan. 16, however, I came across another cluster of ant-tended Jassids of the same species on the stem of a different plant, and at rest close to them was a similar larva over which the ants were running. I then felt that the association must be more than accidental, so I cut the stem through and transferred it to a glass tube. Most of the Homoptera managed to evade capture by jumping off, but I secured three which soon gathered together again on the stem. By the evening the ants were ministering to them and caressing them with their antennae, and, as I watched, the larva crawled slowly in the direction of the insects, stopping frequently and vibrating all three pairs of true legs. It stopped when it had nearly reached the Jassids, and then again moved on with, I believe, only the first pair of legs in vibration. It then reached the insects and caused its vibrating legs to play on the closed wings of a Jassid, in such a way as to simulate, as I thought, the caresses of ants.

"Still advancing, it gradually raised the fore-part of its body so as to overhang the insect and, when well above, suddenly dropped and seized its prey with all its true legs.

"The larva immediately bit in behind the head, holding the insect pressed down on the stem, and when it had taken several mouthfuls, it raised the fore-part of its body and continued feeding, now holding the Jassid well away from the stem. The victim was by this time incapable of movement, and as the larva had no difficulty in retaining it by means of its second and third pair of legs, the first pair was used to take up loose fragments, and guide them to the mouth. I saw a loose leg thus taken up and eaten, and in this way every particle of the unfortunate little 'hopper' was secured.

"After the meal the legs of the first pair were drawn one after the other between the mandibles, and then polished on the outer side of the face, after the manner of a cat.

"I continued to watch the larva closely. It remained without movement for about twenty minutes and then approached another Jassid. This one was evidently not satisfied as to the honesty of its purpose, for immediately the larva commenced to tickle it, the Jassid ran away up the stem to a distance of about half an inch. However, the larva followed on and overtook it, and in due course it shared the fate of its predecessor, the series of actions by the larva being precisely the same as described in the former case.

"I was up early next morning on the hunt for more of the food-insects, and the larva first found made up for its long fast by catching nine out of eleven between 8 a.m. and 3 p.m.

"The procedure was so interesting to me that I actually witnessed the caressing, capture, and eating of most of these, and I have seen it many times since. The caterpillars eat both nymphs and imagos of the Jassids, but seem to secure more of the former, for though these are able to jump and run with surprising activity, quite as fast as an ordinary ant, the imagos sometimes escape by flying. When imagos are eaten, the hard anterior wings are usually rejected. The perfect and imperfect forms are certainly of the same species; for I have seen, and now send, a partially emerged imago. The Jassids of all stages congregate on young shoots of a variety of plants, and are frequently covered by 'shelters' built by ants.

"I have considerable difficulty in obtaining a sufficient quantity of food-insects for the larvae and find it necessary to enclose them, stem and all, in a wide-mouthed jar containing chloroform vapour, and then, when they are overcome, I can transfer them to the tube containing the caterpillars.

"In nature the slow-moving Lycaenid larva must depend for its very existence on the fact that these insects are gregarious and if disturbed frequently re-assemble at the same spot.

"The egg-masses of these Jassids are attached to plants in clusters, much like those of the Membracids, *Leptocentrus altifrons*, Walk. (p. 496), viz. in parallel rows often superimposed so as to form oval masses; the Lycaenid larva does not interfere with these.

"The ants in attendance on the Jassids frequently run over these caterpillars and stroke them with their antennae, but are not so attentive as they are to other Lycaenid larvae. I do not think that the ants obtain any secretions from the caterpillars, and I have not made out the existence of either dorsal gland or tubercles."

A further note from a letter dated Jan. 20, 1912, is as follows :—

"If the caterpillar is on a broad surface it raises itself anteriorly when grasping a victim, but when on a narrow surface it drags the insect off its support by simply bending to one or other side."

A note dated Jan. 22, 1912, runs thus :—

"I went out collecting again to-day and filled my tubes with so much material that, when I found the Jassids required as food for my larvae, I was obliged to drop the 6 obtained into a tube containing a stem bearing *Stictococci* with their attendant ants, *C. buchneri alligatrix.* When I reached home I found that these ants had attacked 2 of the Jassids and were running about with them in their jaws. I rescued them, but they were so badly injured that they soon died. One of the carnivorous larvae pupated late in the afternoon of Jan. 20, and the other is now in the resting condition, which is a relief, for I have had difficulty in obtaining enough of the food-insects, and, though I found other Jassids very closely allied, the larva refused them." The collection contains 6 of the above-mentioned *alligatrix* with confirmatory data.

More of the same species are referred to in the following notes written on Jan. 29, 1912.

"No. 621 A—D. I have now 3 more pupae and 1 larva which are, I feel almost sure, *Megalopalpus*, and the interesting point about them is that they would not take the Jassid *Nehela ornata* which was eaten by my 2 previous larvae.

"Larva 621 A was found in the forest near Oni, on Jan. 22, 1912, in an ant-shelter on *Triumfetta cordifolia*, Guill. and Perr. There were no Jassids at all in this shelter, but it covered a large number of little green hopping creatures which look to me like immature Membracids. [Seven Membracid larvae of various sizes with 45 ☿ min. and 2 ☿ maj. *Pheidole aurivillii kasaiensis*.]

[From this point as far as p. 468 many observations on the relationship between ants and *Membracidae* are recorded. These pages should be read in connexion with Section D, pp. 494–8.]

"I placed the larva in a tube with some of the Jassids [4 *Nehela ornata*], but it had eaten none by the following morning, Jan. 23. I thereupon introduced the top of a *Triumfetta*, bearing shelters containing ants [*Pheidole rotundata*, var., 11 ☿ min., 1 ☿ maj.], and little Membracid larvae. The ants swarmed out and seized the Jassids and they ran all over the larva, one seizing it by an anal clasper exposed as it stretched across between two leaves. The larva did not feed but suspended itself for pupation and on Jan. 24 house-ants of the same species, *P. rotundata*, var. [26 ☿ min., 1 ☿ maj.] came in but did not seem to want to molest it though they ran all over it." The larva subsequently died.

"The second larva, 621 B, was found in the forest near Oni, on Jan. 23 in a shelter on *Triumfetta* containing the ants, *Pheidole aurivillii kasaiensis* [21 ☿] and Membracid larvae [13 of various stages]. I saw this Lycaenid larva feeding on a large larva of the Membracid type though I did not actually witness the attack. The caterpillar ate the body and then part of the head, but was unable to finish its meal, for a tiny ant, which had been dragging persistently at the remaining morsel, managed to get it away.

"On Jan. 24 I admitted the small black house-ants, *P. rotundata*, and I am under the impression that their attitude to the caterpillar was distinctly hostile.

"The larva duly pupated and on pulling away the leaves of the *Triumfetta* so as to break down the ant-shelter I found on the stem a tiny white Lepidopterous egg-shell, which I have since learnt to be that of *Megalopalpus*." The pupa died.

Membracid larvae similar to those mentioned under 621 B have been bred out and the species has been determined by Mr. W. L. Distant as *Gargara variegata*, Sign. Four examples bred from the earlier stages are in the collection sent, one of them accompanied by the nymph-case from which it emerged.

The account continues :—

" 621 C. ♀. The larva of the butterfly C was also found in a similar ant-shelter. I have mislaid my precise notes about it, but I know that one of these larvae—this particular one I believe—was attacked by house-ants, *P. rotundata* [5 ☿ min., 1 ☿ maj.], one of which fastened on to one of its legs, so that I had to remove it." The 6 *Pheidole* are accompanied by the note " 621 C. House-ants found in box with larva, 24. i. 1912."

The labels on 621 C give the following information :—

Larva, forest 1 mile E., Jan. 23; pupation, Jan. 27; emergence about 9 a.m., Feb. 2.

" Another larva, 621 D, was also found on Jan. 25, on breaking into a shelter constructed like the others, on *Triumfetta*, by *P. aurivillii kasaiensis*. [Twenty-nine ants of this species from the shelter are in the collection, together with 23 immature Membracids of various stages and 2 imagines of very different species. One resembles *Anchon relatum*, but is in very poor condition, while the other is a very small species perhaps of the genus *Gargara*.] These shelters so efficiently conceal their contents that on breaking this one open four days later I found a second half-grown *Megalopalpus* larva inside, the presence of which I had not suspected.

" I put a new shelter containing *Pheidole rotundata*, var. [17 ☿ dated Jan. 29] and Membracid larvae into the tube. An ant immediately seized the *Megalopalpus* larva ventrally just behind the mandibles. This larva was not successfully reared.

" I should have mentioned that a fully developed Membracid, attended by ants, was feeding near the shelter in which 621 D was found, and another similarly near the shelter of 621 A and 621 B." [These specimens were not sent, and probably escaped.]

This note concludes the observations recorded Jan. 29.

An ant-shelter on *Triumfetta* often contains, in addition to immature forms of *Gargara*, young *Membracidae* of several other species. The precise determination of these has not been possible, for they have not yet been bred out, but, judging by their general characteristics, they probably belong to the genera *Anchon* and *Beninia*. One frequently finds Membracid imagines of the genera *Anchon*, *Beninia* or *Gargara* feeding in the open on a stem close to an ant-shelter and tended by ants from it, and though these shelters are usually constructed by a species of *Pheidole*, yet it is not uncommon to find them also built by the ants, *Camponotus akwapimensis*, var. *poultoni*, and containing the same Membracids. This latter ant was the only one taken in the following shelters, etc., found, unless otherwise described, on *Triumfetta* in the forest near Oni Clearing, Jan. 27, 1912 :—

Shelter E. Eighteen larval Membracids of various stages and at least 2 species, fragments of the shelter, 4 ants.

Shelter F. Twenty-five larval Membracids of various stages and at least 2 species, 7 ants.

Shelter G. Twenty-eight larval Membracids as above, 4 ants.

Shelter H. Twenty-two larval stages almost certainly of the Jassid *Nehela ornata*, 3 ants.

From another shelter near Oni Clearing, also examined Jan. 27, but not noted as on *Triumfetta*, 1 mature Membracid, probably *Beninia lamborni* (p. 517).

On Jan. 26, in the forest ½ mile E., on *Triumfetta*, but not noted as from a shelter, 1 mature Membracid, evidently *Beninia*, sp., and probably *B. lamborni*, but in poor condition, with 1 ant.

On Feb. 26, on a stem in the forest ½ mile E., 21 mature *Nehela ornata*, 2 larvae probably of the same species, 8 ants ☿ min., varying much in size.

A note dated Feb. 10, 1912, is as follows :—

"I have another pupa of *Megalopalpus* from a larva which ate a species of Membracid closely allied to *Gargara variegata*, although it refused this species."

The chrysalis referred to cannot be that of No. 673, which did not pupate till Feb. 13.

"No. 673, Feb. 26, 1912. This *Megalopalpus* took a rather different Membracid from other Lycaenids I have reared. I have bred one of its food-insects from larva to imago, and am now sending it labelled 'of especial importance,' for I do not know where to get any more for identification."

The specimens sent under 673 are *Megalopalpus zymna* ♀; larva in the forest, ½ mile E., Feb. 7; pupation, Feb. 13; emergence, Feb. 25: *Leptocentrus altifrons* and the nymph-case from which it emerged; larva in the forest, Feb. 17; emergence, Feb. 23. The *Leptocentrus* is labelled "food-insect of 673."

A note of Mar. 7, 1912, runs :—

"*Megalopalpus* usually deposits its egg in the immediate neighbourhood of a colony of the food-insects, but I have sometimes found an egg on the egg-mass of the insect. In one case it was on the eggs of the Membracid, *Leptocentrus altifrons*, Walk., but I could not find this again so as to watch the progress of the larva, and, though I am familiar with the immature forms of *Leptocentrus*, I have never seen the larva eat them. [The history of No. 673 shows that this last statement is mistaken: see above. E. B. P.]

"The egg of *Megalopalpus* is very characteristic, being a circular disc with a broad flattened white margin and a raised bluish semitransparent centre.

"On March 5 I found two nymphs in the same colony of the Membracids *Gargara variegata* unsheltered by ants and each bearing an egg of *Megalopalpus*: in one case on the right side of the dorsal surface of the abdomen just behind the wing, and in the other on the base of the left wing. ["Forest 1½ miles E." on labels of the two specimens.]

"The larvae were on opposite sides of the stem and I did not examine them very closely at the time of capture for fear of losing them, but when I got home I found one eggshell empty though I did not see any larva."

Further notes on ants and the ova of *Lycaenidae*, etc., are as follows :—

"April 29, 1912. The eggs of some Lycaenids seem to be specially protected. I have seen a *Liptena lybissa*, Hew., deposit an egg on a dead stick, and a few days later I saw a Lycaenid unknown to me deposit two eggs right in the path of a procession of black ants running between the ground and their nest which was placed 20 feet up on a tree-trunk. The ants were all round her as she oviposited.

"I have several times watched *Megalopalpus zymna* deposit a single egg among ants which have subsequently investigated it with their antennae but have not interfered with it. The eggs of various species of other families, however, are sometimes greedily taken by ants. A *Charaxes ussheri*, Butler, in my possession laid, on Mar. 17, 1912, 8 eggs, 6 of which were eaten in the night by the small black ants, *P. rotundata*, var."

"June 3, 1912. I am sending a white *Larinopoda* which I saw deposit an egg on a dead stick. There were no ants on it, but they were abundant on leaves of other plants in the neighbourhood.

"May 13, 1912. I saw to-day a number of the *Oecophylla* ants carrying off the larvae of the Saturnian moth *Bunaea alcinöe*, Stoll, as they hatched from the egg."

The following notes refer to the relationship between *Megalopalpus* butterflies, Homoptera and ants :—

"Dec. 29, 1911. I took an *M. zymna* ♀ on the same stem with a Membracid, *L. altifrons*, and 4 attendant ants, *P. aurivillii kasaiensis* [3 are in the collection], all being so sluggish that I readily secured them between the bottle and cork of a killing bottle. The butterfly was probing with its proboscis under and around the Membracid, and I am quite sure that the proboscis occasionally touched the insect's body." ["Forest ½ mile E." on specimens.]

"Jan. 10, 1912. I took two *Megalopalpus* ♂ ♀, which were probing with their tongues under and around a Membracid, *Anchon relatum*, Dist. [the type of the species, p. 516], near to which were 2 immature and 1 mature *Nehela ornata*. Seven ants, *P. aurivillii kasaiensis*, were in attendance." ["Forest 1 mile E." is on specimen, together with a note which apparently implies that the butterflies were probing the Jassids as well as the Membracid. E. B. P.]

"Jan. 15, 1912 : Forest ½ mile E. I obtained 2 *Megalopalpus* [1 ♂ only in collection] sucking food from the fore-wing of one or other of 2 Membracids, *Leptocentrus altifrons*, which were on a green stem, side by side and attended by 19 *P. aurivillii kasaiensis*."

"Jan. 21, 1912 : Forest ½ mile E. I took a ♂ *Megalopalpus* sucking food off the fore-wings of 3 Jassids, *Nehela ornata* [labelled as the food-insects of No. 603 A, B, p. 459]. Nine *P. aurivillii kasaiensis* were in attendance."

"Feb. 7, 1912 : Forest ½ mile E. I took, on a green stem, a ♀ *Megalopalpus* probing with its tongue and evidently sucking up food material from 3 Jassids, *Nehela ornata* [the type and paratypes of the species, p. 519], which were attended by 5 ants." [Of the 5 ants which now accompany the specimens, 3 are *P. aurivillii kasaiensis* while 2 appear to be *P. rotundata*, var., although they bear the name of the former species as the determination. It is probable that there has been an error in the labelling since the specimens were received from Switzerland, and that the 5 ants sent by Mr. Lamborn and named by Prof. Forel were all *kasaiensis*.]

"Mar. 9, 1912: Forest ½ mile E. I captured a ♂ *Megalopalpus* probing with its proboscis a larva of a Membracid, probably *Gargara variegata*, eaten by its own larva. Seventeen ants, *P. aurivillii kasaiensis*, were in attendance."

The sluggishness of *Megalopalpus zymna* when feeding is well shown by the behaviour recorded in Proc. Ent. Soc. 1913, p. xxii. The following note gives additional details :—

"June 3, 1912. On May 28, I saw a worn *Megalopalpus* feeding, ½ mile E., on a fresh leafless shoot covered with sticky secretion which ants were also enjoying. On May 29 I saw the same specimen in the same position, so, with a view to identifying it subsequently, I trimmed its right hind-wing off square with a pair of scissors. When released, it flew into a shrub near by, but it had returned on the following morning and was again feeding. I saw it again on the twig on May 30 [and on May 31 as recorded on the label], and I took it in my fingers and put it in the killing-bottle in the early evening of June 1."

[The following observations upon Oriental *Lycaenidae* allied to the Ethiopian *Megalopalpus* have a very direct bearing upon the facts recorded in the present paper by Mr. Lamborn. E. B. P.]

Mr. J. C. W. Kershaw, F.L.S., in an account of the life-history of *Gerydus chinensis*, Felder (Trans. Ent. Soc. 1905, pp. 1–4, Pl. I.), states that the butterfly lays its eggs towards evening, alighting "in the midst of the Aphides and ants, which she thrusts aside with a brushing movement of her tail, immediately laying a single egg. She then generally moves slightly and remains for some time sucking up the exuding juice of the plant; . . . The ants do not appear to meddle either with the butterflies or the eggs, though ants are very destructive to eggs of most butterflies, . . . Nor do they seem to interfere with the larvae." Mr. Kershaw describes the larvae feeding "on the Aphides, sometimes pressing them against the plant with head and fore-legs, sometimes holding them in the fore-legs quite away from the plant. A few bites disposes of an Aphis and the larva then licks and cleans its legs, just as a Mantis does." Mr. Kershaw found that the larvae, after having eaten one kind of Aphis, were quite ready to take others of a different kind, in this respect differing from Mr. Lamborn's *Megalopalpus*. Furthermore, Mr. Kershaw has not observed *Gerydus* in the perfect state feeding upon the secretions of the Aphis or exploring them with its proboscis. With these slight exceptions the procedure of *Gerydus*, as described by Mr. Kershaw, and *Megalopalpus* seems to be nearly the same and points to a close affinity between these Oriental and Ethiopian forms.

The late Col. C. T. Bingham in the "Fauna of British India—Butterflies," vol. ii, 1907, pp. 287–288, describes and figures an observation by Col. H. J. W. Barrow, who states that *Allotinus horsfieldi*, Moore, "settles over a mass of Aphides and then tickles them with its proboscis, just as ants do with their antennae, and seems to feed on their exudations." The figure represents the butterfly clasping an Aphid between its two anterior legs. Barrow states that the butterfly was not attacked by ants. *Allotinus* belongs to the *Gerydinae* and is the genus next to *Gerydus*, the Oriental representative of the Ethiopian *Megalopalpus*. The observation was made at Maymyo, near Mandalay. Col. Barrow's account has been confirmed, except as regards the position of the anterior legs, by Mr. J. C. Moulton, Curator of the Sarawak Museum, Kuching, who showed the figure in Col. Bingham's book to his Dyak collectors and has thus been able to record similar observations (Proc. Ent. Soc. 1910, pp. xxxviii–xli) upon *Allotinus nivalis*, H. H. Druce, and an allied species. Moulton's Dyak collector also observed *A. horsfieldi* attending "Heteropterous larvae?" but the group to which the latter have been assigned requires confirmation.

A letter recently received from Mr. J. C. Moulton states that the same relationship between Lycaenids and Aphides was observed by the late Mr. R. Shelford in Borneo and also twice by the writer himself. Finally, in the same letter, Mr. Moulton records a recent observation still nearer to those of Mr. Lamborn in that the Homoptera were *Membracidae*:—

"I watched some few months ago a group of ants, a Lycaenid belonging to the sub-fam. *Gerydinae*, and

Homoptera (identified by Distant as the Membracid, *Ebhul varius*, Walker, previously only known from the unique Burmese type). The Membracids were quite passive while ants vigorously massaged them and imbibed the exuding liquid. The *Gerydus* rested within a foot of an ant, slowly stroking an Homopteron with his proboscis and I suppose at the same time drawing up liquid."

Mr. Moulton's letter was hurriedly written and is undated, but it is evident that the observation was made in the neighbourhood of Kuching in the course of the present year, 1913. E. B. P.

8. *Lachnocnema bibulus*, F.

The associated ant was *Camponotus akwapimensis* v. *poultoni*.

In this case, as in *Megalopalpus*, I have not discovered that the larva is of any direct benefit to the ants; for no glandular apparatus was found on it; but although it is protected by coarse hairs the ants certainly treat it with more consideration than they show to *Megalopalpus*, and in one case I gained the impression that they were endeavouring to feed it in spite of its habit of preying on their Homopterous protégés. The notes are as follows :—

"No. 692 A: Feb. 26, 1912. Forest near Oni. I found yesterday a new Lepidopterous larva, much like that of *Megalopalpus*, on a tree, on which were a number of tiny Homopterous larvae attended by ants. [The Homoptera have since been described as Jassids, *Ossana bicolor*, Dist. (p. 519), and the ants as *C. akwapimensis*, var. *poultoni*.]

"I have not yet seen this larva eat any of the insects, but I have observed it passing its mouth to and fro over them as if it might be obtaining food, and I have frequently seen the ants feed it with material obtained from the insect larvae. An ant and a larva stand in front of each other mouth to mouth. Some jerky movements take place, the ant stroking the larva with its antennae after the manner of an *Oecophylla* ant which, having stored itself with water, proceeds to dispense it to its fellows."

"No. 692 A, ♂: Mar. 7, 1912. This butterfly was bred from the larva which I thought was fed by ants. I have since speculated as to whether I might not have been mistaken in thinking that the ants feed the larvae.

Perhaps the position is reversed, and it is the larva that provides the ants with food, possibly buccal secretion or regurgitated material, since it has no dorsal gland. When I first had the larva it did not feed, as far as I could see, for 24 hours unless the ants gave it food, but it then ate a number of the Jassids. I imagine that these carnivorous larvae when they find a colony of food-insects have to make as big a meal as they can so as to be prepared against a possibly long wait before they find others.

No. 692 B, ♀. The larva was found in the forest ½ mile E., on Mar. 3, and pupated on Mar. 7, 1912. "It ate the same food-insect as larva A, and they were attended by the same ants."

No. 692 C, ♀. The larva was found in the forest ½ mile E., on Mar. 7, and pupated on Mar. 11. "It ate the same Jassids as larva A, and the same ants were in attendance on them."

Pupation of A, Mar. 1; B, Mar. 7; C, Mar. 11; emergence of A, 7 a.m., Mar. 10; B, Mar. 16; C, Mar. 20.

The Jassids, *O. bicolor*, were in each case found on similar food-plants, as yet undetermined. Nine mature and 17 immature Jassids in various stages were sent, together with 11 ☿ minor and 2 ☿ major *C. akwapimensis* v. *poultoni*—both Jassids and ants collected in the forest near Oni Clearing, Mar. 7, 1912. One ☿ major is the type of the variety. Five of the larval Jassids are different from the others and may perhaps be *Nehela ornata*.

9. *Deudorix* (*Hypokopelates*) *obscura*, Bethune-Baker, sp. n. (p. 501).

The associated ant was *Cremastogaster buchneri* r. *alligatrix*.

No. 796. The larvae of the 2 male butterflies under this number were soft-bodied vegetable feeders. The note, May 26, 1912, runs: "The larvae of these 2 Lycaenids were found in the forest 1½ miles E., on May 4, 1912. They were attended by a large number of ants, but I did not discover the source of attraction to them, for, as far as I could see, neither gland nor tubercles were present.

"The butterflies were new to me but may have been confused with others." Fourteen ants were in attendance.

Pupation, May 9; emergence, May 16.

10. *Myrina silenus*, F.

The associated ants are probably *Camponotus maculatus* and *C. akwapimensis* v. *poultoni*.

A note bearing on the relationship between the larvae and ants was communicated on my behalf by Prof. Poulton in 1911 (Proc. Ent. Soc., pp. xcix–c). The ants in attendance seem to have been mostly the larger species, e. g. *Camponotus maculatus*, F., ? subsp., and *C. akwapimensis* v. *poultoni*, but little work has been done on these larvae since that time.

No. 696, ♀, the only specimen bred since 1911, was attended in the larval state by ants, but these have been lost. They were, however, I feel sure, *C. akwapimensis* v. *poultoni*.

The larva was found in Oni Clearing Mar. 1, 1912, pupated Mar. 4, and the butterfly emerged Mar. 14.

11. *Myrina subornata*, Lathy.

The associated ant, only in the house, was *Pheidole rotundata*, var.

No. 694. The note referring to this ♀ specimen is extracted from a letter dated Mar. 24, 1912 :—

"The larva of this Lycaenid resembled very closely that of *Myrina silenus*. It was found Mar. 1, 1½ miles E. of Oni camp, on a small tree in the centre of a native village—a position unfavourable to the presence of ants, and there were none in attendance. The larva, however, had both dorsal gland and tubercles, and the small black house-ants (*Pheidole rotundata*, var.) found their way to it very soon after I brought it home. The tubercles were exserted on tactile stimulation. The pupa also was like that of *Myrina silenus*, and the small black ants covered it completely with débris, though it was suspended in a vertical position. The larva did not feed while in my possession." It was found on the food-plant of the Bombycid moth *Norasuma kolga*, Druce, and on the undersurface of the leaves were numerous colonies of the Coccids, *Dactylopius longispinus*, Targ.-Tozz., which, as already reported in the Proc. Ent. Soc., 1912, p. xviii, are eaten by the larva of the Lycaenid, *Spalgis lemolea*, H. H. Druce.

The larva of this *Myrina* bore a close resemblance to that of *M. silenus* and was, moreover, found on a species of fig-tree to which family the food-plant of *M. silenus* is to be referred, so that I have no doubt that it also is a plant-eater. Pupation occurred Mar. 5 and emergence Mar. 14.

12. *Hypolycaena nigra*, Bethune-Baker, sp. n. (p. 502).

The associated ant was *Pheidole aurivillii* r. *kasaiensis.*

No. 653, A—I. The ♂ type of the species is G, the ♀ type D. The note referring to these 9 butterflies (8 ♀, 1 ♂) is as follows :—

"Feb. 26, 1912. The larvae were all found in the forest, 1½ miles E., on two adjacent leaves, on Feb. 4. I am sure they are all of one company." The larvae were soft, green, and onisciform in shape. Of the numerous attendant ants, *P. aurivillii kasaiensis,* 16 were sent.

All the larvae pupated Feb. 5; A—E emerged 8 a.m. and flew about 9.30 a.m., Feb. 13; F and G (the only male), about 8.30 a.m. and flew 10 a.m., Feb. 13; H, 7 a.m., and I, before 7 a.m., Feb. 14.

13. *Hypolycaena* (*Zeltus*) *lebona*, Hew.

The associated ant was *Pheidole aurivillii* r. *kasaiensis.*

No. 595. A note of Jan. 18, 1912, refers to a female specimen :—

"I am sending a Lycaenid butterfly, with the 8 precise ants which were in attendance on its larva. I was able to see the dorsal gland in this, but was not sure as to the presence of the tubercles. The larva eats the cortex of the young shoots, and rarely the upper or lower surface of the leaves of the wild 'bush-yam' called 'Ewo' in the Yoruba tongue."

The 8 ants in attendance were *P. aurivillii kasaiensis.*

The larva was found in the forest 1 mile E., Jan. 4; pupation, Jan. 7; emergence, 7 a.m., Jan. 16.

No. 627. My note referring to a male specimen is as follows :—

"Jan. 29, 1912. The larva of this Lycaenid was deep green in colour. The orifice of the dorsal gland was conspicuous, having reddish lips : at the usual site of the tubercles were white spots, but I did not see the structures protruded."

Four *P. aurivillii* r. *kasaiensis,* in attendance, were sent with the imago. The larva was found Jan. 12, in the forest, 1½ miles E.; pupation, Jan. 16; emergence, about 10 a.m.; flight, 11.45 a.m., Jan. 27.

14. *Hypolycaena philippus*, F.

The associated ants were *Pheidole aurivillii kasaiensis* (probably), *Ph. rotundata*, var. (in the house as well as in the open), *Camponotus akwapimensis* v. *poultoni*, and *C. maculatus*, the latter as an exception.

A note bearing on the relationship between these larvae and ants was communicated on my behalf to this Society by Prof. Poulton on Dec. 6, 1911 (Proceedings, pp. c–ci). The ants therein mentioned as being in attendance on the larvae when found are now recognised, after a study of Prof. Forel's recent determinations, as a species of *Pheidole*, very probably *aurivillii* r. *kasaiensis*, whereas the " house ants " which came and attended the larvae in captivity were certainly *Pheidole rotundata*, var. The following butterflies were bred during 1912 :—

No. 643, a female specimen, was reared from a larva found on Jan. 31, 1912, in forest ½ mile E., and 3 *C. akwapimensis* v. *poultoni* were in attendance on it. The larva was then transferred to another plant in Oni Clearing near my house, and, on Feb. 4, six *P. rotundata*, var., were removed from it.

Pupation, Feb. 5; emergence, about 9 a.m., Feb. 12.

No. 675, a male specimen, was bred from a larva found in Oni Clearing on Feb. 14, 1912 : 3 *P. rotundata*, var., were in attendance.

Pupation, Feb. 16; emergence, Feb. 25.

A third larva, which died Jan. 16, was found Jan. 12 in Oni Clearing with a single *Camponotus maculatus*, F., subsp. ?, in attendance. This ant is in my experience an unusual attendant of *H. philippus*.

15. *Argiolaus alcibiades*, Kirby.

The associated ant was a race of *Cremastogaster buchneri*.

No. 805. A letter dated June 10, 1912, states that the pupa of this ♀ Lycaenid was found June 2, in the forest 1½ miles E., on a leaf of *Culcasia scandens*, Beauv. (*Aroideae*), a plant of ivy-like habit, climbing up a Kola tree on which was a huge nest of black ants which were scattered everywhere on the plants. The ants were undoubtedly a race of *Cremastogaster buchneri*.

Emergence, June 6.

16. *Argiolaus julus*, Hew.

The associated ant was a race of *Cremastogaster buchneri*.

No. 765 A—C. Two males and 1 female. The note in my letter, dated May 13, 1912, is as follows :—

" The larvae of these *Lycaenidae* were ant-attended and had each a dorsal gland, though I could not see any tubercles. The three were found together in the forest 1½ miles E., on a climbing parasitic plant. They were wonderfully coloured, ruby and green being predominant."

Unfortunately the precise ants in attendance were not collected, but they were undoubtedly a race of *C. buchneri*. The larvae were plant-eaters.

All pupated Apr. 23 and emerged May 3.

17. *Spalgis lemolea*, H. H. Druce (*S-signata*, Holl.).

The Coccid food of the larva has been recorded in the Proceedings of this Society (1911, pp. civ–cv; 1912, p. xviii). Additional notes on these larvae and their food-insects are reproduced below :—

" Jan. 7, 1912. I had repeatedly examined the Coccids without detecting the larvae, and it was only my attempt to find a particularly large Coccid for examination that led me to turn one over and discover it to be Lepidopterous."

" Feb. 18, 1912. The larvae of *Spalgis lemolea* do not strike me as being much larger than the Coccids on which they feed, for they are rather flattened and usually nestle up closely to the masses of Coccids under what appears to be a common covering of shed cuticles, etc. It is sometimes really quite difficult to distinguish them. The Coccids are so closely packed and so well covered that one can rarely see the form of a single individual."

" June 15, 1912. I have watched several *Spalgis* ovipositing on the Coccid masses, and am now sending some larvae in spirit. It is quite common to see tiny Coccids wandering in the material on the back of the larvae."

Some of the Coccids, as eaten by the larvae of *Spalgis*, from the plant " Pride of Barbados " in Oni Clearing, May 25, 1912, were sent in spirit, and these, when examined by Prof. Newstead, F.R.S., were found to be *Dactylopius virgatus*, var. *madagascariensis*, Newst. (p. 523). The food-insects previously sent were determined by the same authority as *D. longispinus*, Targ.-Tozz. (Proceedings, 1912, p. xviii); hence the larvae of *Spalgis lemolea* are not confined to a single species of Coccid. Although the condition of the specimens was such that Prof. Newstead cannot be certain about either determination, he is nevertheless quite sure that the species are different.

18. *Lycaenesthes* sp. ? *alberta*, Bethune-Baker.

The associated ant was *Cremastogaster buchneri* r. *clariventris*.

The specimens are stunted so that their determination was difficult. Mr. Bethune-Baker, however, after comparing them with the type of *alberta*, considers that they probably belong to the same species.

The following note refers to three bred specimens, 1 ♂ 2 ♀:—

No. 705. Mar. 24, 1912. "The larvae of these *Lycaenidae* were all obtained at Idakun on one plant on March 13. A dorsal gland and tubercles were present in the usual situation and a great number of ants, rather different from any others I have sent, were in attendance."

The ants, which numbered 31, have been determined as *C. buchneri*, Forel, r. *clariventris*, Mayr.

All three pupated Mar. 15 and emerged Mar. 23.

19. *Lycaenesthes liodes*, Hew.

This species has a green, onisciform, leaf-eating larva. Notes as to a bred specimen are as follows :—

No. 719, male, April 1, 1912. "This larva had both dorsal gland and tubercles in the usual region. Three ants were in attendance on it when found." These were despatched home but were lost, probably in the post. The imago and its pupa-case arrived safely.

Larva in forest, 1½ miles E., Mar. 20; pupation, Mar. 23; emergence, Mar. 30.

20. *Lycaenesthes silvanus*, Drury.

The associated ants were *Pheidole aurivillii* r. *kasaiensis* (probably) and *Camponotus akwapimensis* v. *poultoni*.

A preliminary note as to the relationship between the larvae of this species and ants was communicated to this Society by Prof. Poulton in 1911 (Proceedings, p. civ).

The larvae are green and onisciform, and are leaf-eaters.

No. 553, A, B. Two males. Dec. 4, 1911. "The larva was found on a leaf with ants in attendance."

Ten *P. aurivillii kasaiensis* are probably the specimens referred to, but decisive data are wanting.

The above note refers to a single specimen, but the lettering probably indicates that the 2 larvae were found together.

A, Larva in forest, 1 mile E., Nov. 23, 1911; pupation, Nov. 26; emergence, about 3 p.m. Dec. 3. B, Larva in forest, 1 mile E.; emergence, about 3 p.m. Dec. 6. No other data.

No. 616, male. Jan. 18, 1912. "The larva was found in the forest, 1½ miles E., on Jan. 11, with two ants in attendance. It had both dorsal gland and tubercles, the former hard to see owing to the absence of any special pigmentation."

The two ants were *C. akwapimensis* v. *poultoni.*

Pupation, Jan. 15; emergence, Jan. 22.

21. *Lycaenesthes larydas*, Cram.

The associated ants were *Camponotus akwapimensis* v. *poultoni* and *Pheidole aurivillii* r. *kasaiensis.*

A note on the relationship between these larvae and ants was communicated on my behalf by Prof. Poulton to this Society in 1911 (Proceedings, p. civ).

The larvae of this species were green and onisciform in shape and ate leaves. The notes referring to a long series are as follows :—

No. 611. *L. larydas* ♂. "Jan. 18, 1912. The larva of this Lycaenid, found in the forest near Oni Clearing on Jan. 10, possessed both gland and tubercles, which were sometimes protruded when I tickled it." It ate the food-plant of the Pierine *Terias senegalensis*, Boisd., and 3 ants in attendance on it were *C. akwapimensis* v. *poultoni.*

Pupation, Jan. 13; emergence, about 2 p.m., Jan. 21.

No. 613. *L. larydas*, ♀, tending to *kersteni*, Gerst. "The larva was found ½ mile east of our camp on Jan. 8, 1912, and two ants were in attendance." These also were *C. akwapimensis* v. *poultoni.*

Pupation, Jan. 13; emergence, Jan. 21.

No. 614. *L. larydas*, ♀, tending to *kersteni.* "Jan. 18, 1912. The larva possessed a dorsal gland, but the orifice was hard to see, not being marked out by pigment. Two white tubercles were present and were protruded on tickling with a wisp of cotton wool." Larva in the forest near Oni Camp; imago emerged Jan. 22. No other data.

No. 617. *L. larydas*, ♂. "The larva was found on Jan. 8, 1912, in forest ½ mile E. of Camp. There was only one ant in attendance on it, a large ☿ min. of *C. akwapimensis* v. *poultoni*."

Pupation, Jan. 13; emergence, Jan. 22.

No. 623. *L. larydas*, ♂. Jan. 29, 1912. "I found the orifice of the dorsal gland in the larva of this specimen and detected the sites of the tubercles, but I could not cause them to be protruded."

One *C. akwapimensis* v. *poultoni* was in attendance on the larva, Jan. 14.

Larva in forest near Oni Clearing, Jan. 14; pupation, Jan. 19; emergence, Jan. 26.

No. 628. *L. larydas*, ♀, deformed.

"The larva was found ½ mile east of camp on Jan. 15, 1912." One *C. akwapimensis* v. *poultoni* was in attendance.

Pupation, Jan. 17; emergence, Jan. 28.

No. 639. *L. larydas*, ♂, tending to *kersteni*.

The larva was found in the forest ½ mile E., on Jan. 26, 1912, and 9 ants, *P. aurivillii kasaiensis* were in attendance on it. A note dated Feb. 5, 1912, records that both dorsal gland and tubercles existed in the larva.

Pupation, Jan. 29; emergence, before 9 a.m., Feb. 5.

No. 641. *L. larydas*, ♂, tending slightly to *kersteni*.

The larva was found in the forest, 1½ miles E., on Jan. 26, 1912, and 4 ants, *P. aurivillii kasaiensis*, were in attendance on it. A note dated Feb. 5 is as follows: "I saw the dorsal gland in the case of this larva, and tubercles were put out when I tickled it."

Pupation, Jan. 29; emergence, before 10 a.m., Feb. 5.

No. 669. *L. larydas*, ♀, tending to *kersteni*.

The larva of the specimen was found in the forest, ½ mile E., on Feb. 13, 1912. One ant only, a *C. akwapimensis* v. *poultoni*, was in attendance.

Emergence, Feb. 22.

22. *Lycaenesthes lachares*, Hew.

The associated ants were *Pheidole aurivillii* r. *kasaiensis* and *Ph. rotundata*, var., the latter in the house as well as in the open.

[The females of *lachares* from the neighbourhood of Oni differ from the ordinary form of this sex in the absence or slight development of the yellow patch in the centre of the upper surface of each wing. Hewitson's type in the British Museum, from the Cameroons, has the patch strongly developed in each fore-wing, weakly in each hind.

Mr. W. A. Lamborn has sent 10 females captured on the following dates: 1910, March 26—two, April 5—one, May 24—one; 1911, Jan. 1—six. These last 6 were taken in one spot, and had evidently only just emerged from the pupa. The only specimen with the yellow patches conspicuous is that taken April 5, 1910. In all the others they are wanting, or very slightly developed. All these specimens are shown on Plate XXVI, figs. 1–10.

The relative development of the yellow marks in the females of the following series of bred specimens has been described as carefully as possible in order that comparison may be made with the above-mentioned captured females, and it will be found that this feature is, upon the whole, far more prominent in the former. The comparison suggests that artificial conditions, acting as a shock, have tended to cause reversion to the normal pattern of the species. The extent to which these yellow marks appeared, differed greatly in the females of the different groups, each of which was bred from larvae found together and therefore developed from the eggs of a single female. This difference is probably to be accounted for by differing hereditary tendencies towards reversion, so that, although the shock has probably been of the same general kind, the effects produced are far from uniform.

The whole of the bred females except No. 612, arranged in their little families, are represented on Plate XXVI, figs. 11–30.

Modification of the under surface, probably in consequence of artificial conditions, is also represented on figs. 31–39 of the same Plate. Figs. 31–36 represent the males and 37–38 the females of a single family (No. 615, p. 481), while fig. 39 represents the underside of a captured female for comparison with the two latter. It will be noted that the pattern of fig. 36 is extraordinarily different from that of the other males, although fig. 35 is slightly transitional towards it. Furthermore, the two females, especially that shown in fig. 38, have undergone somewhat similar modifications. It will be noticed that by far the greatest change, as shown in figs. 36 and 38, has been undergone by the smallest individuals, namely, by those which have presumably been most strongly affected by the artificial conditions.

The upper surface of the male shown in fig. 36 is also remarkable in the possession of a distinct pale submarginal line, increasing in brightness and breadth towards the anal angle of both wings, but stronger in the hind-wing. The very peculiar pattern of the under surface is also visible through the slightly transparent wings and gives to the insect a peculiar and characteristic appearance. The upper surface of the male represented in fig. 35 is transitional towards that above described. E. B. P.]

The larvae were of the usual green onisciform type. The following note, referring to specimens numbered 605, 607, 609, 615, was written on Jan. 18, 1912 :—

" I am sending a long series of these Lycaenids grouped for the sake of precision under several numbers. The larvae of all, except those labelled 604, came off one shrub near Oni Clearing, on and about Jan. 10, 1912. The two, labelled 604, were taken, Jan. 11, ½ mile E. of camp. These larvae were always found under leaves and in groups which I have kept distinct, and all were ant-attended. They showed a tendency to conceal themselves by drawing leaves together, especially when about to pupate. The eight larvae the imagos of which are numbered 615 were found together and six of them pupated under a leaf lightly attached to the wall of the box. House-ants replaced in most cases the usual attendant ants. I have mislaid a note on the position of the dorsal gland but it is present in the usual situation, and the paired tubercles were extruded on weak tactile stimulation.

" The larvae were all leaf-green, but became reddish, and exhibited oblique stripes of a lighter shade about 36 hours before pupation. All the imagos emerged about 8 to 9 a.m.—*never* earlier—and all flew about 10–10.30 a.m." [605 C, D and 607 J appear to have been exceptions.]

The history of these 4 separate groups is as follows :—

No. 605. Six larvae found together under one leaf were attended by 18 ants, *P. aurivillii kasaiensis*, and 1 male and 5 female butterflies were bred from them.

No. 607. Five larvae, under one leaf, attended by 18 *P. aurivillii kasaiensis*, gave 2 male and 3 female butterflies.

No. 609. Two larvae under one leaf, which were attended by 7 *P. aurivillii kasaiensis*, gave 1 male and 1 female butterfly.

No. 615. Eight larvae under one leaf were attended by no less than 41 *P. aurivillii kasaiensis*. Six male and 2 female butterflies were bred from these.

The dates of pupation and emergence, etc., of the above-mentioned groups 605 to 615, found on a single shrub on or about Jan. 10, 1912, are shown below in tabular form :—

Group No. and date of capture.	Date of Pupation.	Date and hour of Emergence.	Sex, Reference Letter, and Fig. on Plate XXVI.	Development of yellow marks on wings of female.
605. Larvae found Jan. 10.	Jan. 12	Jan. 20 : about 10.0 a.m.	C ♀ Fig. 26	Yellow marks distinct in all four wings, and strong in all except D.
	,, 12	,, 21 : ,, 10.0 a.m.	D ♀ ,, 27	
	,, 13	,, 21 : ,, 8.0 a.m.	E ♀ ,, 28	
	,, 13	,, 21 : ,, 8.0 a.m.	F ♀ ,, 29	
	,, 13	,, 21 : ,, 8.0 a.m.	G ♀ ,, 30	
	,, 13	,, 22 : ,, 8.0 a.m.	H ♂	
607. Jan. 10.	Jan. 13	Jan. 21 : 8.30 a.m.	I ♀ Fig. 16	Distinct but not strong in I and K, very feeble in J.
	,, 13	,, 21 : flew 9.0 a.m.	J ♀ ,, 17	
	,, 13	,, 21 : 8.30 a.m.	K ♀ ,, 18	
	,, 13	,, 21 : flew 10.0 a.m.	L ♂	
	,, 13	,, 22 : 8.0 a.m.	M ♂	
609. Jan. 10.	Jan. 12	Jan. 21 : about 8.0 a.m.	N ♀ Fig. 24	Strongly developed.
	,, 13	,, 22 ,, 8.0–9.0 a.m.	O ♂	
615. About Jan. 10.	Jan. 12	Jan. 21 : 8.0 a.m.	P ♀ Figs. 11 and 37	Only faintest trace of marks on all wings of P and U. The ♂ W an extraordinary var., especially on under surface (p. 479).
	,, 13	,, 22 : about 8.0–9.0 a.m.	Q ♂ Fig. 31	
	,, 13	,, 22 : ,, 8.0–9.0 a.m.	R ♂ ,, 32	
	,, 13	,, 22 : ,, 8.0–9.0 a.m.	S ♂ ,, 33	
	,, 13	,, 22 : ,, 8.0–9.0 a.m.	T ♂ ,, 34	
	,, 13	,, 22 : ,, 8.0–9.0 a.m.	U ♀ Figs. 12 and 38	
	Unrecorded	,, 23 : ,, 8.0 a.m.	V ♂ Fig. 35	
	,,	,, 23 : ,, 8.0 a.m.	W ♂ ,, 36	

Other bred specimens are :—

No. 604. Two *L. lachares*, both females (Plate XXVI, figs. 19, 20). Although number 604 is earlier than those of the groups already described, the larvae were captured later and are therefore treated in this position. The two larvae were found under one leaf, in the forest ½ mile E., Jan. 11, 1912 : pupation, Jan. 13; emergence of ♀ A, 9 a.m., Jan. 20, of ♀ B, 8 a.m., Jan. 21.

Three *P. aurivillii kasaiensis* were in attendance on the larvae.

The yellow marks are well developed on the wings of both females, but not quite so strongly as on those of 605.

No. 612. *L. lachares*, ♀. " Jan. 18, 1912. This larva had a dorsal gland rather more conspicuous than in most, because the anterior and posterior lips were pink in the mid-line and white on each side. Tubercles of the usual kind were present." Larva, near Clearing, Jan. 10; pupation, Jan. 12; emergence 8 a.m., Jan. 21.

Yellow marks well developed—as in 605 C.

No. 631. One *L. lachares*, ♀ (Plate XXVI, fig. 14). The larva was found on Jan. 20th, in forest 1 mile E. Six *P. rotundata* are accompanied by the note " 631. Ants in attendance on larva when found." Pupation, Jan. 22; emergence, about 10 a.m., Jan. 31. Distinct trace of yellow marks on fore-wings, extremely faint on hind.

No. 632. Two *L. lachares*, 1 male and 1 female (Plate XXVI, fig. 13). The larvae of these were found together on Jan. 20, in the forest, ½ mile E. No ants were sent home with the specimens, so that it is doubtful as to whether the larvae were ant-attended when discovered, but as soon as they were placed in a box the house-ants, *P. rotundata*, to the number of nine, 8 ☿ min. and 1 ☿ maj., came and attended them.

Both pupated Jan. 24 and emerged Feb. 2.

Faintest trace of yellow on all wings of female—even less than on 615 P and U.

No. 637. One *L. lachares*, male. The larva was found in forest, ½ mile E., Jan. 24, 1912, with three *P. aurivillii kasaiensis* in attendance on it. A note dated Feb. 5 runs as follows : " The larva of this Lycaenid was green. The orifice of the dorsal gland was indicated by two bright pink spots, one in the middle of each lip. I did not succeed in getting the larva to put out its tubercles, but there were dark patches in the region where these are usually found."

Pupation, Jan. 30; emergence, before 9 a.m., Feb. 5.

Nos. 665, 666 and 667, all *L. lachares*, were bred from larvae found on one plant 1 mile E. on Feb. 9, 1912.

No. 665. A female (Plate XXVI, fig. 25) was bred from a larva found on a leaf by itself with 2 *P. aurivillii kasaiensis* in attendance.

Pupation, Feb. 12; emergence, about 8 a.m., Feb. 20. The yellow patches are strongly marked.

No. 666. Two males and 3 females (Plate XXVI, figs. 21–23) were bred from larvae on one leaf attended by *P. rotundata*, var., which were removed. House-ants of the same species subsequently covered the pupae with débris, traces of which may be seen on 2 out of the 3 pupae in the collection. Eleven *P. rotundata*, var., are accompanied by the note "ants in attendance on 5 larvae, Feb. 9, 1912." It is worthy of note that the other ants taken from the same bush were *P. aurivillii kasaiensis*.

All pupated Feb. 12 and emerged Feb. 20,—1 male at 8 a.m., the remaining butterflies at about this hour. The females were strongly yellow-marked on fore-wing, rather less so on hind-wing.

No. 667. A female (Plate XXVI, fig. 15) was bred from a larva with 6 *P. aurivillii kasaiensis* in attendance.

Pupation, Feb. 12; emergence, about 8 a.m., Feb. 20. The wings, especially the fore-wings, are slightly but distinctly yellow-marked.

23. *Lycaenesthes flavomaculata*, Smith and Kirby.

The associated ants were *Odontomachus haematodes* and *Cremastogaster buchneri*, races *winkleri* and *alligatrix*. Also, in the house, *Pheidole rotundata*, var.

No. 602, A—C, 2 males and 1 female were bred from 3 larvae found side by side under a leaf in the forest, ½ mile E., on Jan. 9, 1912. A note dated Jan. 18, thus refers to them: "The precise ants, 18 *C. buchneri winkleri*, in attendance on the larvae are sent. I was able to see with the unaided eye the orifice of the dorsal gland in the usual situation. In the case of one larva a droplet of watery fluid exuded from it. I could not detect any special taste to it, but I subsequently watched the house-ants, *P. rotundata*, var., which adopted the larvae, drinking it. I could see no tubercles, though a light spot on each side in the usual situation suggested that they might be present. The larvae dropped to the ground when I started ant-catching."

All pupated Jan. 11. ♀ A emerged 10 a.m., ♂ B about 10.30 a.m., Jan. 19; ♂ C 9 a.m., and flew 10 a.m., Jan. 20.

No. 638. A male butterfly was bred from a larva found in the forest near Oni Clearing, Jan. 24, 1912.

"Feb. 5, 1912. The larva had a dorsal gland, but the orifice was not indicated by special pigmentation. No tubercles were extruded when I tickled the larva, but on one occasion only a drop of fluid—tasteless to me—exuded from the orifice of the gland." One ant, *Odontomachus haematodes*, L., was in attendance on the larva. I have not before noted the association of any ant of this genus with Lycaenids.

Emergence before 10 a.m., Feb. 5.

No. 640. A male butterfly was bred from a larva found in the forest near Oni Clearing, on Jan. 28, 1912. Ten ants were in attendance [identified by Prof. Forel as *C. buchneri alligatrix*. Mr. W. C. Crawley and Mr. A. H. Hamm, after a careful examination, are convinced that one out of the ten is a typical example of the race *winkleri*]. On the evening of Jan. 28, three *P. rotundata*, var., were taken off the larva in the house. The following note, dated Feb. 5, refers to this larva :—

" The dorsal gland was seen, but no tubercles. I watched house-ants on the larva with a hand-lens, and actually saw one drink up fluid from the gland."

Emergence, Feb. 5.

No. 651. A female specimen was bred from a larva found in the forest ½ mile E., on Jan. 27, 1912. Seven ants were in attendance. [Of these 3 bear Prof. Forel's determination *C. buchneri alligatrix* and 4 his determination *C. buchneri winkleri*. All bear the number " 651." Mr. W. C. Crawley and Mr. A. H. Hamm, after examining these specimens and comparing them with Prof. Forel's descriptious, conclude that the 4 labelled *winkleri* are, although intermediate, nearer to *alligatrix*.]

Pupation, Jan. 31; emergence, Feb. 8.

24. *Neurypexina lyzanius*, Hew.

The associated ant was *Pheidole rotundata*, var.

No. 579, A—F. Two male and 4 female butterflies. The note dated Jan. 8, 1912, refers to these as follows :—

" The larvae of these 6 Lycaenids were found in the forest ½ mile E., Dec. 28, 1911. They were all close together on the new shoots of a broken stem, but they were non-gregarious. They were attended by *P. rotundata*, var., but I was obliged to collect all the attendant ants in one box, so that it will not be possible to arrange particular groups with their original Lycaenids." Twenty-one *P. rotundata* were labelled " in attendance," 18 " on other parts of the same plant," while 12 others cannot be placed with certainty in either category.

Pupation, ♂ B, Dec. 31; 1 ♂ 4 ♀, Jan. 1. Emergence, ♀ A, Jan. 8; 2 ♂ 3 ♀, Jan. 9. ♂ B and ♀ C emerged about 9 a.m.

No. 600. A male butterfly was bred from a larva found in the forest ½ mile E., on Jan. 5, 1912. No less than 37 *P. rotundata*, var., were on the same leaf, many concentrating their attention on the larva.

Pupation, Jan. 10; emergence about 2 p.m., Jan. 18. A note records that the larva was the same as 579 A—F.

25. *Triclema lucretilis*, Hew.

The female of this species is described by Mr. Bethune-Baker on p. 503. The associated ants were *Cremastogaster buchneri*, races *alligatrix* and *winkleri*. Also, in the house, *P. rotundata*, var.

No. 555. A single male specimen. A note dated Nov. 27, 1911, runs :—

" I recently found 4 remarkable Lycaenid larvae, though 3 have since died and the remaining 1 is sickly. I first saw a little dark green larva in a pit which it had gnawed in the dark green cortex of a soft plant. It was small, and I removed it carefully for the purpose of an examination with a lens. There were numerous ants on it (*C. buchneri alligatrix* *). Having examined it, I replaced it on the stem and it soon crawled down and vanished into a hole out of which ants had been coming. I found 2 other small larvae on the stem, and a fourth could be seen just inside another hole.

" I opened up a stem, and in so doing, cut into a larva inside it. The ants, which bite and so produce a little temporary skin irritation, came rushing out in numbers."

Larva in forest 1½ miles E., Nov. 22; pupation, Nov. 27; emergence, 8 a.m., Dec. 7. This male butterfly is somewhat dwarfed, and the blue markings on the upper surface are much reduced. The pale markings on the under surface are yellow.

A further note referring to the same ants on Jan. 10, 1912, runs thus : " These particular ants bite savagely, and when alarmed run about with abdomen uplifted and turned forwards over the thorax."

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* The 7 ants sent as examples of those attending 555 were collected at a later date, viz. Jan. 10, 1912.

The note of Nov. 27 continues: "I found that the pith in the centre of the stem had largely been eaten away and that on the inner side were a number of little pits. In some of the older tunnels thus produced were white scale insects. Normal stems have no central cavity."

I feel confident that the larvae of *Triclema* eat only the young cortex of this particular plant, and that the presence of Coccids is accidental as far as they are concerned, although there probably is relationship between the Coccids and the ants.

No. 657. Five male and 3 female butterflies. One of these latter is the specimen described by Mr. Bethune-Baker (p. 503). A note in my letter of Feb. 26, 1912, records that no less than 12 pupae were found in the forest ½ mile E., on about Feb. 13, in the central cavity of a stem similar to that already mentioned. Three of the pupae were injured in opening it up and one other pupa died. Ants, undoubtedly one of the races of *C. buchneri*, were running in and out of holes in the stem as in the preceding case. The stem was suspended in a box in my bungalow, and, on Feb. 14, twenty-three "house-ants," *P. rotundata*, var., were collected off the pupae.

One male emerged about 7.30 a.m., Feb. 14, the remaining butterflies about 8 a.m., and probably on the same date. Four ants bear the note "ants in cavity of stem with the 12 pupae. Feb. 13, 1912." [Owing to some error these examples were not sent to Prof. Forel, but Mr. W. C. Crawley and Mr. A. H. Hamm are confident that they are *C. buchneri winkleri*.]

No. 660. Two female butterflies. Three pupae were found in the forest near Oni, in a similar hollowed stem about Feb. 13, but one died. The precise ants in attendance on them have been mislaid, but they were undoubtedly a race of *C. buchneri*.

One butterfly emerged about 9 a.m. Feb. 15, the other about 8 a.m. Feb. 16.

[Both specimens, as well as No. 663 (p. 487), are somewhat dwarfed, and their upper surface is of a uniform fuscous tint with barely a trace of the markings of the normal females as described by Mr. Bethune-Baker (p. 503). The under-surface markings are much yellower than in any of Mr. Lamborn's 5 normal females, in this respect resembling males 555 and 662. In order to confirm the sex, Mr. Eltringham kindly mounted and examined a fore-foot of the specimen which emerged Feb. 16. E. B. P.]

No. 662. This male specimen was bred from a larva found in the forest 1½ miles E. on Feb. 4, 1912, which pupated Feb. 6, and emerged Feb. 16. The ants running in and out of the cavity were *C. buchneri* r. *winkleri*, of which 11 were sent.* The following note, dated Feb. 26, refers to the specimen :—

"This Lycaenid was walled up in the stem when in the pupal state by débris brought by house-ants, *P. rotundata*, var. These butterflies when freshly emerged seem to me to possess an excessive amount of downy material about the coxae and ventral surface of the body which frequently gets rubbed off and deposited on the edges of the opening by which they leave the stem."

[F. P. Dodd, in "Entomologist," 1902, p. 184, speaks of the thick covering of loose scales by which the freshly emerged *Liphyra brassolis*, Westw., is protected from the attacks of *Oecophylla* ants.]

The hollow stem which contained the pupa still retains plenty of the débris brought by the house-ants.

No. 663. A female specimen was bred from a larva found in the forest 1½ miles E., Feb. 2, 1912, on a similar stem. It was attended by a race of *C. buchneri*.

Pupation, Feb. 7; emergence, Feb. 16. This specimen is dwarfed, dark, and yellow-marked beneath like females 660 (p. 486).

No. 670. Two female butterflies were bred from larvae found on a similar stem in the same locality, Feb. 14, 1912. They entered the central cavity on Feb. 15, and consequently I lost sight of them. Ants were as usual in attendance, but though none were sent home they were without doubt a race of *C. buchneri*.

One butterfly emerged Feb. 22, the other was flying 8 a.m.; the date unrecorded, but probably Feb. 22.

The association of the particular ants *C. buchneri* with the larvae in nature is perhaps to be explained by the fact that these ants favour the particular tree, which provides food for the larvae, as a site for their carton nests.

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* Four ants only were determined by Prof. Forel, but Mr. Crawley and Mr. Hamm have no doubt that the whole series belongs to the race *winkleri*.

26. *Cupido* (*Catochrysops*) *malathana*, Boisd.

The associated ant was *Camponotus akwapimensis* v. *poultoni*. Also, in the house, *Pheidole rotundata*, var.

No. 581. ♂. The following note refers to the larva of the specimen :—

"Jan. 7–8, 1912. On Jan. 5 I discovered a small Lycaenid larva which had eaten an oval hole in the side of a seed-pod and was half inside and half out of it. The seed-pod belonged to a Leguminous climbing plant with a flower very like that of our French bean.

"Five ☿ min. and 1 ☿ maj. *C. akwapimensis poultoni* were running to and fro on the pod, the centre of interest being the larva. On the dorsal aspect of the visible half of its body was a small dull-red area over which an ant was standing head down and holding his ground all the time against the attempts of others to come there. I secured all these ants and they are now sent. On arriving home I discovered a drop of fluid rather larger than a pin's head on this patch. I shut the larva up closely and left it for the night. On the same day I had found two *Oboronia* pupae in a head of the plant *Costus afer*, and had left them on my verandah table. I found next morning that the small black 'house-ants,' *P. rotundata*, var., had made an attempt to cover them with bits of wool, excreta of caterpillars and tiny fragments of wood, so I took away the pupae, and the ants scattered over the table. I then opened the box containing the *Catochrysops* larva which had left the seed-pod, and the ants very soon swarmed over it. I removed all the ants save three so that I was then able to watch the proceedings without difficulty.

"The ants undoubtedly obtained food-material from the red patch, but behind and to its outer side I observed, on either side, a little white tubercle which was protruded and drawn in again repeatedly, and with such great rapidity that one could hardly count its movements. I then took away two more ants. The remaining one fed at the red patch, and now that the other ants were no longer running over the larva the two tubercles remained protruded. Presently the ant made a rush at one of the tubercles which was promptly withdrawn. It then ran over to the second tubercle. This was withdrawn in turn, but the first tubercle was thrust out again and incited the ant to rush back a fraction of a second too late to secure anything, for the tubercle had been already retracted. This happened repeatedly, and I then took away the ant and examined the structures more closely.

"The larva, green in colour and onisciform in shape, is about 7 mm. in length. The red patch, which is about 2 mm. long and 1 mm. broad, is situated in the mid-dorsal line of segments 10 and 11. It is diamond-shaped and the anterior angle is produced forwards and constitutes the area on segment 10. I feel sure that with a lens I can see a crescentic opening, with the concavity directed backwards, in the portion of the patch on segment 11.

"Both tubercles are on segment 12, 3 mm. behind and to the outer side of the patch, and 4 mm. from the mid-dorsal line, and their length when fully extended is, according to my estimate, 1 mm. The tubercle is white, and, with a lens, one can see a ring of tiny bristles forming a fringe encircling its blunt and rounded apex. When the ants are removed, the tubercles are only to be seen for about half a minute, and when they are retracted one cannot detect the exact spot at which they were extruded, but a weak tactile stimulus will cause one or other to reappear.

"The larva subsequently entered the little seed-pod again and ate out the whole of the interior, voiding a large quantity of pale green excreta. It spent the whole of yesterday crawling about without taking food, and to-day (Jan. 8) it has become motionless and is almost concealed under débris piled up by the ants (*P. rotundata*). If this happens under natural conditions the covering must effectually conceal the pupae."

The following data accompany No. 581. Larva in forest 1½ miles E. Jan, 5, 1912; pupation, Jan. 9; emergence, 10.45 a.m., Jan. 16; flew about 11.45 a.m. Of the 6 *C. akwapimensis poultoni* attending larva Jan. 5, one is a ☿ major, and 3 of the minors are much larger than the other 2. Eight of the *P. rotundata*, var., attending the larva from Jan. 6 were also sent, together with the material heaped by them over the resting larva on Jan. 8; also the seed-pod and the pupa-case.

27. *Cupido* (*Oboronia*) *punctata*, Dew.

The associated ants were *Pheidole aurivillii kasaiensis* and *P. rotundata*, var., the latter in the open as well as in the house.

Various notes on the habits of the larva were communicated for me by Prof. Poulton to this Society in 1911 (Proceedings, pp. ci–civ). The ants which construct a nest over the head of the plant *Costus afer*, Ker.-Gawl. (*Scitamineae*), in the calyces of which the larva lives, have since been determined as belonging to the genus *Pheidole*, and two species are probably concerned, viz. *P. aurivillii kasaiensis* and *P. rotundata*, the former being more usually found.

No. 442. The 15 butterflies of this series were all bred from larvae and pupae found in the calyces of *Costus afer* between Sept. 11 and Oct. 7, 1911. All were covered in by nests built up by *Pheidole*. The larvae and pupae were found in Oni Clearing and in the forest at various points up to 1½ miles E., the majority coming from this latter distance. Specimens D, E, F, G, J, O and P (all males) bear notes stating that they emerged at 9 a.m., and an eighth unlettered ♂ specimen "about 9 a.m." Only 2 specimens, B, ♀, and G were captured as larvae, on Sept. 10 and 13 respectively: they pupated Sept. 11 and 15 and emerged Sept. 21 and 26. Of the remainder A, C, and K are ♂, I, L, and N ♀. Nearly all the pupa-cases are contained in the calyces of the food-plant—never more than one in each. The remainder are attached to the scale-like leaves of the flower-head.

No. 474. The female parent, referred to in Proceedings, 1911, p. cii, was captured in a swamp in Oni Clearing, Sept. 18, 1911. She died and was partially eaten by ants Sept. 21. The 3 probable offspring, all ♂, emerged Oct. 2, 6, and 7 respectively. The larvae and pupae were tended by house-ants, *P. rotundata*. The conditions of the breeding experiment, as described in the Proceedings, leave little doubt that these 3 butterflies are the offspring of 474 and therefore that the cycle from egg to imago is run through very rapidly.

No. 580, A ♀ and B ♂. Two pupae were found in Oni Clearing on Jan. 4, 1912, in the usual situation on *Costus afer*, and 50 *P. aurivillii kasaiensis* were collected from the ants' nest. On Jan. 6 the pupae were covered in the house with material brought by *Pheidole rotundata*, 20 of which, 19 ☿ min. and 1 ☿ maj., were collected.

Emergence of A, Jan. 6; of B, 9 a.m. Jan. 9.

No. 582, ♀. One pupa was found Jan. 3, 1912, in Oni Clearing in a calyx of *Costus afer* covered by a nest of

P. aurivillii kasaiensis; the imago emerged Jan. 7: 31 ☿ min. and 1 ☿ maj. were collected from the nest.

"Jan. 15, 1912. The small black house-ants, *P. rotundata*, var., covered up the pupa as it lay on my table with particles of wood, wool and other rubbish, including the egg-shells of a Saturnian moth and the shed caudal horn of a Sphinx larva."

"Jan. 15, 1912. With a view to attracting more ants I left a lump of sugar on the table and an attempt to cover this also was made. These ants liked the sugar very much, but they are also carnivorous and had devoured a small green Mantis which I had left on the table dead.

"I found a small box containing tiny red house-ants and their larvae which I placed on a table where the small black house-ants (*P. rotundata*, var.) come. The latter soon vanquished the former and carried them off with their larvae."

No. 596, ♀. The larva was found on Jan. 2, 1912, in Oni Clearing in a head of *Costus afer.* The butterfly emerged on Jan. 15, about 7 a.m.; 7 ☿ min. and 2 ☿ maj. of *Pheidole rotundata* were collected Jan. 2, from the nest covering the head of the plant.

No. 597, ♂. The pupa was found in Oni Clearing in a head of *Costus afer* on Jan. 14, 1912, and the imago emerged on Jan. 15 about 7 a.m.; 13 *P. aurivillii kasaiensis* were collected Jan. 14 from the nest covering the head of plant.

C.—CARNIVOROUS MOTH-LARVAE AND MOTH-LARVAE ASSOCIATED WITH ANTS.

1. *Eublemma ochrochroa*, Hampson (*Erastrianae*).

These little Noctuid moths were compared in the British Museum with the type of the species, from Sierra Leone.

No. 776. The larva of this moth was found near Oni Clearing on Mar. 29, 1912, and a note dated May 13 thus refers to it:—

"The larva was very remarkable. I discovered a stem of *Triumfetta cordifolia* bearing Coccids, *Stictococcus sjöstedti*, on the secretions of which *Oecophylla* ants were feeding. Among the Coccids was a small brown oval structure, apparently of silk, fixed to the bark. I took it to be a cocoon and so brought it home, but by and by the structure moved with considerable rapidity, and I then saw that it consisted of a case concealing a purple caterpillar. This covering was not an intrinsic part of the larva, for I believe that the latter was able to turn round almost completely beneath it. I certainly saw its head very near where the anal extremity had been and from time to time at the side. The larva ate one Coccid and then became quiescent, having sealed down its covering to the stem on all sides. The cocoon-like structure sent is really the covering of the active larva. Though I was able to see very little of it I felt certain that this larva was Lycaenid; for I have found other larvae which I am sure were *Lycaenidae* under coverings of débris. Accordingly when a little moth emerged I did not connect it with the cocoon until two days later, when I noticed for the first time the valve-like aperture by which it had made its exit."

Pupation about Mar. 31, emergence Apr. 10. A *Stictococcus* is still attached to the stick bearing the cocoon.

No. 826. The larva of this moth was found near Oni Clearing on May 22, 1912, and is referred to in the following note :—

" July 1. The larva of this moth was carnivorous and was found moving among *Oecophylla* ants and feeding on Coccids, *Stictococcus sjöstedti*, the food of the larva of *Aslauga lamborni*. The ants were feeding on the secretions of the Coccids. The larva was protected by a rounded covering of silk in which were the remains of *Stictococci*, and this covering served to form the cocoon."

Pupation about May 26, emergence June 24. A *Stictococcus* is also attached to the stick bearing the cocoon, and remains of *Stictococci* are clearly visible in the walls of the latter.

2. Probably *Euproctis* sp. (*Lymantridae*).

No. 844. The larva of this little Lymantrid moth was found near ants, June 24, 1912, in the forest 1½ E. It spun June 26, and the perfect insect emerged July 8. The moth itself bears a remarkable superficial resemblance to a Lithosid of the genus *Miltochrista*.

3. *Obtusipalpalis saltusalis*, Schaus (*Schoenobiinae*).

The larvae and pupae of this Pyralid moth live in the flower-heads of *Costus afer* among the *Pheidole* ants which tend the larvae and pupae of the Lycaenid, *Oboronia punctata* (see pp. 489–91, also Proceedings, 1911, pp. ciii, civ).

No. 484 A and B. The pupa of A was found Oct. 7, 1911, in an ants' nest in a head of *Costus afer* in Oni Clearing. The moth emerged Oct. 10. The larva of B was found, Sept. 27, 1911, in a similar situation in the forest 1½ E. The moth appeared Oct. 10.

4. *Tinthia lambornella*, Durrant, sp. n. (p. 513) (*Egeriidae*).

No. 674. The following note refers to the single bred specimen.

"Feb. 26, 1912. The larva of this Aegeriid moth was maggot-like, and lived inside a stem which I cut open in my search for *Lycaenidae*. These particular stems are often hollowed out by a large ant (*Sima aethiops*, Smith ♀) which lives inside in company with some scale insects, samples of which are sent in spirit. The ants often form communities of 6 or 7 [probably workers with a ♀] in an internode and have larvae with them."

The moth larva was found by itself in an internode, but ants were found in those on either side of it. The moth is accompanied by its pupa-case in a hollow stem, together with 9 ♀ *Sima*, bearing the date Feb. 29, and 2 stems similar to those which they inhabit. A note states that the ants were found each in a separate internode, at Alo, 4 miles E. of Oni. [The date of the above note (Feb. 26) shows that the moth larva was not taken with these particular ants.]

5. *Tortrix callopista*, Durrant, sp. n. (p. 513).

No. 625. The larva of this moth was found in the forest 1½ miles E., on Jan. 14. My note concerning it is as follows :—

"Jan. 15, 1912. On going yesterday to obtain more Coccids as food for Lycaenid larvae, I discovered, on the stem of the same plant, some inanimate objects which looked very like Lycaenid larvae. In the walls of each were imbedded a number of *Stictococci*. On attempting to remove one with scissors I found that it was hollow and contained a maggot-like Lepidopterous larva, and that the wall covering the larva was composed of silk with brown material containing the Coccids on its outer side."

"Jan. 29, 1912. This tiny moth was bred, Jan. 27, from a larva, similar to one sent in spirit, which I found in a tunnel constructed under *Stictococci* which are eaten by the larva of *Aslauga lamborni.* I have since found that the little moth larvae eat out the inside of the Coccids, attacking them from underneath, and when one is eaten they construct a tunnel so as lead to and get beneath another."

It is probable that the minute Lepidopterous larva which Prof. R. Newstead describes as preying upon *S. sjöstedti* is allied to *T. callopista* (see p. 522, also Journ. Econ. Biol., vol. v, 1910, p. 22).

D.—ANTS AND MEMBRACIDAE.

The following section deals with the relationship between ants and *Membracidae* and incidentally includes observations on the life-history of one species,—*L. altifrons.* This section should be read in connexion with that upon *Megalopalpus zymna* (p. 458) and especially pp. 463–468, where many other observations on *Membracidae* and their attendant ants are recorded.

1. *Leptocentrus altifrons*, Walker (see also p. 516).

No. 38. " These insects are fairly plentiful on the growing stem of the food-plant of *Acraea bonasia*, F.— *Triumfetta cordifolia*, Guill. and Perr., var. *hollandii*, Sprague (*Tiliaceae*), and I see them occasionally on that of *A. parrhasia*, F. —*Urera obovata*, Benth. (*Urticaceae*). They are invariably attended by ants. Sometimes they are found singly and sometimes there are several together. They are easily examined in situ, but hard to catch, as they jump off to an astonishing distance and take to flight with great suddenness."

The 14 specimens bearing No. 38 were found Oct. 14, 1911, in the forest 1½ miles E. Accompanying them is an egg-mass on *Urera obovata*, with the same data.

Companies of mature forms are frequently found, but never as far as I remember on green stems, and I am disposed to think that these massed individuals are invariably such as have only just emerged from the nymph condition and that they scatter when hardened up. (See also Proc. Ent. Soc. 1913, pp. xxxvi–xxxvii, and xxxvii footnote.) One frequently finds mature forms feeding on green stems but rarely more than two together, and they are invariably ant-attended. Thus among the specimens sent is a single large *L. altifrons*, found Jan. 14, 1912, on a green stem in the forest ½ mile E., together with the 2 attendant ants, *C. akwapimensis* v. *poultoni.*

The solicitude of ants for the larvae has a very definite object, for they are extremely partial to the fluid excreted at the anal extremity, and I remember seeing a *C. akwapimensis* v. *poultoni* with the caudal whip of a Membracid larva actually in its mouth. [The same attraction is also described by J. C. Kershaw in Ann. Soc. Ent. Belg., Vol. LVII, 1913, p. 191.]

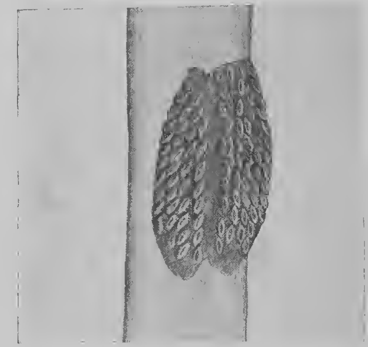
The attraction exercised on ants by mature forms is not so clear, but in some cases it has seemed to me that the ants have obtained edible material off the wings. The ants usually in attendance on this species are *C. akwapimensis* v. *poultoni*, but two mature specimens found near Oni Clearing about Jan. 6, 1912, were attended by *Pheidole rotundata*, var. These Membracids, No. 54, were found near a shelter containing larvae, probably of the same species, of which 7 were sent, accompanied by the 18 *P. rotundata*, var., which attended both larvae and imagines.

Oviposition. A note referring to a female specimen runs as follows :—

No. 43. "This insect was found ovipositing Oct. 25, 1911, on a stem of the plant, *Triumfetta cordifolia*, Guill. and Perr., var. *hollandii*, Sprague, 1½ miles E. of Oni camp. She sat so closely over the egg-mass that I was able to cut off the twig and place it, without disturbing her, in my killing-bottle. Two ants were in attendance, and one seemed to obtain food-material from her wings." The specimen is much larger than Walker's type of *L. altifrons*, but this may be accounted for by the sex. The twig with the egg-mass (figured on p. 496) is in the collection but the ants were not sent.

Since writing the above, I have found a number of ovipositing females which always exhibited the same astonishing degree of reluctance to quit the egg-mass—so much so indeed that it is always possible to make a close examination with a lens, and, if one wishes to capture such a specimen, it is easily taken between thumb and forefinger, a method of capture which is impossible under ordinary conditions. Oviposition is a lengthy proceeding and lasts from 36 to 48 hours.

I believe, though I have to trust entirely to memory on this point, that the eggs are placed only on the old brown cortex and never on the green stem of any plant. The length of time the female is engaged in oviposition and her apparent insensibility to any danger which may be threatening her must certainly necessitate the careful selection of a site on which she is least likely to be subject to attack, and though on a green stem *Leptocentrus* is a conspicuous object, on a brown stem her dark colour and her shape are, I am sure, of cryptic value, so that she is likely to be detected only by the practised eye. The egg-mass forms an oval structure about 10 mm. long and 8 mm. broad, and the eggs are arranged in parallel rows often superimposed. See the accompanying figure [which shows a condition very different from that described in two Membracids by J. C. Kershaw, *l. c.* pp. 191, 192].



Egg-mass of *Leptocentrus altifrons*: × about 4½.

Hatching and the earliest larval stages.—The following note describes the hatching of larvae which I am now confident are those of *L. altifrons* :—

No. 53. "On Jan. 2, 1912, I watched some Membracid larvae hatching. When first seen, the tiny larvae were just starting to come out of the 2 egg-masses side by side on a twig of *Triumfetta.* Two or 3 had left the eggs and were huddled together ¼ inch higher up the stem. No ants were present. When seen again on Jan. 4, hatching was still in progress and a mass of larvae had collected about an inch above the eggs. The uppermost larvae, viz. those first hatched, were at least double the size of the lowest, and, on the twig below the mass, tiny scattered larvae were crawling up to join the rest of the community.

Large black ants were in attendance. By taking my time I was able to snip off the leaves and secure both larvae and ants on the stem in a test-tube. The soft green bark bore numerous puncture marks at the spot where the larvae had been feeding. When disturbed, the larvae started to run in various directions quite actively. More have hatched out to-day (Jan. 6) and with a lens I can see that when alarmed, even these exude a tiny drop of fluid at the anal extremity, and then run away, frequently backwards."

The following material illustrates the above notes :—

Sixty-eight minute larvae, hatched Jan. 2–4, together with the double egg-mass on *Triumfetta*, another stem showing punctures and 10 attendant *C. akwapimensis* v. *poultoni*—all collected near Oni Clearing, Jan. 4–6, 1912.

Later stages.—The following note refers to a series of 10 larvae, or more probably nymphs, which I now know to be those of *L. altifrons*. They were taken in the forest, 1½ miles E., on Sept. 1, 1911, and are accompanied by 4 of the attendant ants—*C. akwapimensis* v. *poultoni*.

No. 19. " These insects—attended by a great number of ants—were all congregated at the end of a green stem. Perfect insects were present with them, but took the alarm and flew away directly I touched the stem. The larvae or nymphs now sent retreated slowly down the stem, crawling backwards and protruding a pink caudal whip at the end of which a drop of fluid, the size of a pin's head, appeared. If one attempted to catch them, they ran away with great speed or else jumped off suddenly in various directions. On examination of the stem on which they had been, one always found numerous puncture marks for the purpose of feeding."

2. *Neoxiphistes lagosensis*, Dist., gen. et sp. n. (see p. 515).

No. 50. A company of 9 mature forms of these Membracids were found all huddled together on old cortex on Dec. 8, 1911, attended by 9 *C. akwapimensis* v. *poultoni*. These have the same habit of springing away suddenly when disturbed, but my note records that in the early morning they are more sluggish than later in the day. I have never seen companies of this species on a green stem. These specimens, which belong to a new genus and species described by Mr. W. L. Distant on p. 515, were taken in the forest, about 1 mile E. of Oni Camp.

3. *Anchon decoratum,* Dist., sp. n. (p. 516).

No. 48. Two mature examples, the type at Oxford and the paratype in the British Museum, were found together in the forest, 1 mile E., Dec. 3, 1911. Two larvae of different sizes and probably of 2 different species were captured with them, as well as 34 attendant *P. aurivillii kasaiensis.* [The number of the ants suggests that more Membracid larvae or imagines were present, but escaped. E. B. P.]

E.—PSYLLIDAE, ANTS, AND DIPTERA.

1. *Rhinopsylla lamborni,* Newstead, sp. n. (see p. 520).

No. 61. " These insects, *Rhinopsylla lamborni,* are very numerous now. The larvae are found, on plants in the clearing, in large colonies hidden in a white woolly down which is rather sticky. When hunting through this for Lycaenid larvae, on Feb. 18, 1912, I came across some Dipterous larvae and 2 Dipterous pupae, the imagines from which emerged Feb. 24."

These 2 Diptera with their puparia have been submitted to Mr. E. E. Austen who informs me that the species is *Baccha claripennis,* Lw. (*Syrphidae*).

" On Feb. 25 I found numerous mature forms of the *Rhinopsylla,* and, in the ' wool,' other Dipterous pupae. The ant *Camponotus maculatus,* F., is occasionally found obtaining food in the ' wool.' "

Seven Diptera bred, Mar. 2–5, from the above-mentioned pupae, have been determined by Mr. Austen as *Baccha picta,* Wied., or a species very near to it. A single example of the Trypetid fly *Ceratitis punctata,* Wied., also bred Mar. 2–5, Mr. Austen thinks can only have been accidentally present as larva or pupa in the " wool." The carnivorous larvae of the 2 *Syrphidae,* on the other hand, were just where we might have expected to find them.

The collection also contains a " wool "-covered mass of nymphs and large numbers of imagines of *R. lamborni* collected Feb. 25–26. Two pairs were taken *in coitu.*

EXPLANATION OF PLATE XXVI.

Lycaenesthes lachares, Hew., both captured and bred in the Lagos district.

All the figures are slightly below the natural size.

FIGS. 1–10. Females taken (1910–11) in the neighbourhood of Oni; all except the specimen represented in fig. 3, differ from the normal form of this sex in the absence or very slight development of the yellow patch in the centre of each wing (see pp. 478–9).

1 & 2. Mar. 26, 1910. Flitting together in a dry swamp ½ mile N. of Oni.

3. Apr. 5, 1910. In the forest within 3 miles of Oni. The yellow patches strongly developed especially in the fore-wings.

4. May 24, 1910. On a path, Oni Clearing.

5–10. Jan. 1, 1911. All taken at the same spot in the forest 1½ miles E. of Oni: evidently freshly emerged from the pupa.

11–30. Females bred from larvae taken in the neighbourhood of Oni. The figures are arranged to show an increasing development of the yellow patches from left to right. The majority of the bred specimens are shown to contrast strongly with all of the captured ones except fig. 3, and are as a matter of fact the normal form of the species. It is probable that something in the artificial conditions has acted as a shock and caused reversion to the normal type. It will be noted that the development of yellow patches runs with remarkable constancy in each of the little families bred from larvae found together.

"No. 615," and each of the following numbers denotes a separate family.

11, 12. Nos. 615 P & U (p. 481).

13. No. 632 A (p. 482).

14. No. 631 (p. 482).

Explanation of Plate XXVI.

Fig. 15. No. 667 (p. 483).
16–18. Nos. 607 I, J, K (p. 481).
19–20. Nos. 604 A, B (pp. 481–2).
21–23. Nos. 666 D, E, F (p. 483).
24. No. 609 N (p. 481).
25. No. 665 (pp. 482–3).
26–30. Nos. 605 C, D, E, F, G (p. 481).
31–39. The under sides of the whole of the individuals of No. 615 together with that of a captured female for comparison. The figures show that the dwarfing of one male (fig. 36) has been attended by an extraordinary modification of the pattern which more closely approaches that of the two bred females (figs. 37–38) than it does that of any of the other males of the same family (figs. 31–35), or of the wild female (fig. 39).
31–36. The males of No. 615, namely Q, R, S, T, V, W (pp. 479–81).
37–38. The females of No. 615, namely P and U (pp. 479–81). The upper surfaces of these two specimens are represented respectively in the above figs. 11 and 12.
39. The under side of the captured female represented in the above fig. 7.

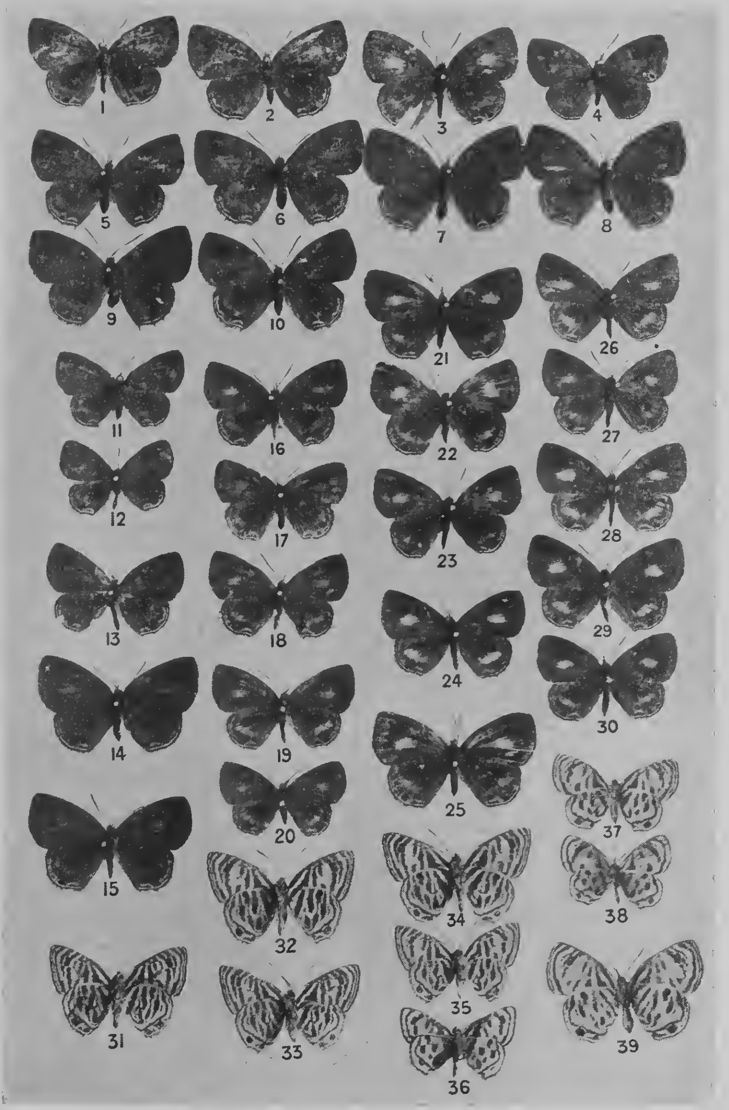


Photo., A. Robinson. *C. Hentschel.*

(*Slightly below natural size.*)

Lycaenesthes lachares. Upper surfaces of captured (1–10) and bred females (11–30), the latter showing, perhaps by reversion, a greater prevalence of the yellow patch. Undersides of males (31–36) and females (37–38) of a single bred family compared with a wild female (39). Lagos district: W. A. Lamborn (1910–12).

APPENDIX

I. *Notes on Lycaenidae collected by W. A. Lamborn in the Lagos district of West Africa with descriptions of new species.* By G. T. Bethune-Baker, Pres. Ent. Soc.

Aslauga vininga, Hew.

The Lagos form of the ♀ of this species is darker than that from Sierra Leone, the central radial portion of the primaries and a small central patch in the secondaries being dull ochreous, whereas the greater portion of the primaries and a large part of the secondaries in those from Sierra Leone is ochreous. There is no doubt that *marginata*, Plötz, is a ♀ synonym of this insect: specimens thought to be males are females, and I have been quite unable to trace the existence of a yellow male.

For observations on the life-history see pp. 446–7.

Aslauga lamborni, sp. n.

♂. Both wings deep steel blue, bluer than in *vininga*. Primaries with costa to the cell black, apex and termen broadly black the latter tapering rapidly to a fine edge at the inner margin. Secondaries with costa black-margined by the cell and vein 7, but extending slightly over vein 7 at the apex.

Underside. Both wings lavender grey sparingly irrorated more or less all over with blackish scales, a slightly paler dash marks the disco-cellulars in each wing. Secondaries with the termen broadly pale lavender grey to vein 6 above which there is a small patch of dark scales.

♀. Both wings uniformly dark brown. Primaries somewhat less dark in the radial area, but this may be due to the specimen not being absolutely fresh. Under surface: both wings pinkish brown with subterminal broadish indefinite dark bands, in the secondaries these are more strongly emphasised below vein 7.

Expanse ♂ 40, ♀ 37 mm.

Types in the Oxford Museum from Oni, near Lagos, also in my collection from Sierra Leone. For the ♂ type see p. 447. The ♀ type was taken 11 a.m., Aug. 27, 1911, resting on the top of a green leaf, in the forest 200 yards from the edge of Oni Clearing.

In this species neither wing is angulated in the middle of the termen as in *vininga*, this difference being specially marked in the secondaries.

See also pp. 447–450.

Aslauga bella, sp. n.

[♀] Both wings grey with slight pale blue suffusions. Primaries dark brownish grey with a bright pale basal blue suffusion extending nearly to the end of the cell and about half way along the inner margin, an oval whitish spot at the end of the cell intersected by a black dash on the disco-cellulars : below this and extending to the inner margin is a suffusion of lavender grey scales adjoining the blue colour, this grey extends for a further quarter of the radial area leaving the terminal quarter dark brownish grey. Secondaries pale brownish grey with a slight suffusion of blue scales in the cell and about half way across the wing but getting less plentiful on the outward area, in both wings this suffusion does not invade the costa above the upper margin of the cell. Fringes white of the secondaries, but only tipped with white near the apex of the primaries.

Underside. Both wings creamy white irrorated sparingly all over with chocolate brown. Primaries with a limited apical area of pale chocolate brown, an oblique pale chocolate stripe becoming double from the apex to vein 2 where it terminates abruptly, a similar single stripe in the secondaries from the middle of the costa to the inner margin terminating at a third from the base.

Expanse 44 mm.

Type in the Oxford Museum from Oni, near Lagos. The pupa was found by Mr. W. A. Lamborn in the forest 1½ miles E. of Oni, on June 30, 1912, the imago, No. 843, emerging July 5.

I am unable to decide which sex this specimen is; the palpi and fore-legs incline me to believe that it is a male, but the size of the abdomen and its terminal segment look like a female. The abdomen and thorax in both sexes of all species of this genus are very robust, whilst it appears to me that each sex can use its fore-legs for walking. I hope Mr. Lamborn will be able to verify this when he returns again.

[Mr. Eltringham has now dissected the terminal segments, and there is no doubt that the specimen is a female.]

From its underside pattern this species is allied to *A. purpurascens*, Holland, rather than to the *vininga* group.

Epitola oniensis, sp. n.

♂. Upperside. Both wings bright rather lustrous blue, somewhat of the colour of a deep sky-blue; in a side light, but only in a side light, with a shade of mauve in it. Primaries with an irregular black wedge-shaped spot at the end of the cell. Costa and termen very broadly deep black, the latter gradually tapering towards the tornus, the blue area is very evenly terminated but has slight black incisions at each of the veins: there is a marked sex brand on the lower margin of the cell the vein being much swollen at the base but rapidly tapering to vein 2; vein 1 is likewise prominent for its basal half, though to a very much less extent. Secondaries with the costa deep black to the cell and to vein 6, termen very broadly black, the disco-cellular veins show very finely black.

Underside. Both wings pale madder brown with whitish markings. Primaries with a few whitish scales in the cell at the base of vein 6 and also near the lower angle of the cell, just beyond the cell is a fine curved irregular and interrupted line of similar scales from vein 9 or 10 to vein 2, a more definite curved and *scalloped postmedian* line from vein 10 to vein 1, a submarginal very obscure and indefinite curved broadish line of very fine scales followed by a similarly obscure marginal row. Secondaries, with a few scattered sub-basal whitish scales, a few more such scales across the cell beyond the middle almost assuming the shape of the figure 8, below which are a few more, just beyond the cell a very irregular interrupted and fine curved line as in the primaries followed by a postmedian curved irregular line from the costa to nearly the inner margin, a submarginal broader line somewhat scalloped: there is no marginal line.

Expanse ♂ 36 mm.

Hab. Oni near Lagos.

Type in the Oxford Museum, captured by W. A. Lamborn at rest "on dry stem" in the forest 1½ miles E. of Oni, Feb. 4, 1911. This species seems to be somewhere near *catuna*, G.-Smith. I have a specimen very near it in my own collection from Sierra Leone.

See also p. 457.

Hypokopelates obscura, sp. n.

♂. Both wings black—dead black—with a very slight interneural suffusion of dark blue scales.

Undersurface. Both wings milky white with a narrowish postmedian stripe of orange. Primaries with orange stripe erect but slightly irregular, a subterminal narrow grey stripe, terminal area broadly grey. Secondaries with the orange stripe with a defined w at the anal angle, a fine crenulate subterminal line to the first anal ocellation. Termen finely black followed by a fine white line which is succeeded by a grey stripe broad at the apex but tapering rapidly to the ocellated spot, this spot is oblong deep velvety black with an orange edging, anal lobe spot velvety black with a few blue metallic scales and an upper and outer edging of deep orange which extends up in a narrow line to join the postmedian orange stripe on the inner margin.

♀. Both wings dull brown. Primaries without any markings. Secondaries with the termen finely black followed by a fine white line and with a sub-terminal whitish suffusion, a darkish spot on the margin between veins 2 and 3 and another at the lobe with a slight pale blue metallic suffusion and an orange line on its inner edge. Underside similar to the male, but the orange coloration is yellow with the exception of the outer edging to the lobe spot which is red.

Expanse ♂ 30, ♀ 32 mm.

Type ♂ in the Oxford Museum from Oni, near Lagos, reared by Mr. Lamborn. Type ♀ in my collection from the Bassa Province, Northern Nigeria.

See also p. 471.

Hypolycaena nigra, sp. n.

♂. Both wings blackish brown. Primaries practically with no blue, though in certain lights it is possible to imagine a slightest trace of steely blue on the fold. Secondaries with a very little more bluish trace, the ground colour lobe spot encircled interiorly with white, a small defined white spot touching the black marginal patch between veins 1 and 2, with a smaller indefinite one above it, outside which nearer the termen is another defined small white spot, two tails a long one by the lobe and a short one from vein 2.

Underside. Both wings white with the usual markings of the genus. Primaries with an even orange oblique postmedian stripe finely edged with black on each side, a submarginal line interrupted at the veins, margin at apex broadly grey tapering rapidly down to a fine line about vein 2. Secondaries with a slightly oblique orange stripe just beyond the cell which is deeply angled near the anal angle and continued upwards to vein 1*a*, this stripe is edged finely with black on each side, a broadish duller orange submarginal stripe starting from the apex and tapering gradually into a narrow dark line by the upper black anal spot below which it is curved and the orange colour re-appears and runs up to vein 1*a* touching the other orange stripe at that point, the least trace of a fine dark marginal line, termen finely black nearly up to the apex, the lobe spot and that between veins 2 and 3 deep black the latter margined internally with orange the former with a trace of a few bluish and orange fine scales.

♀. Both wings brown. Primaries somewhat of an orange tone to beyond the cell whence it becomes sooty brown. Secondaries slightly orange brown for the basal half then becoming of a sooty hue, markings as in the male. Underside of both wings like the male.

Expanse ♂ 34, ♀ 36 mm.

Hab. Lagos, Sierra Leone, Cameroons.

Types in the Oxford Museum from Oni, near Lagos.

Mr. Lamborn has bred the larvae of this species, which appears to be constant. I have it from the Cameroons and from Sierra Leone. It is not unlikely that it has been mixed up with *hatita*, Hew., and with *antifaunus*, Doubl. and Hew. It is not unlike the latter on its upper surface, but is similar to the former below.

See also p. 473.

Triclema lucretilis, Hew.

The female of this species has not yet been recorded, and it is very interesting to know that Mr. Lamborn has bred both sexes at Oni. I now add a description of the female.

♀. Both wings sooty black (not deep black as in the ♂), all the spots showing through in the same positions as in the male but not encircled with blue. Primaries, the subterminal series of blue spots in the ♂ are creamy whitish in the ♀. Secondaries, the blue subterminal line in the ♂ is replaced more strongly by a creamy line in the ♀.

Underside. Similar to the ♂, but with all the white lines and spots more accentuated.

See also pp. 485–7.

II. *The genus* Euliphyra, *Holland.* By Prof. E. B. Poulton, with notes by G. T. Bethune-Baker and H. Eltringham.

Plate XXVII.

Mr. W. A. Lamborn's material throws so clear a light upon the species of this important and puzzling little genus that it seems worth while to write a short revision. This is all the more necessary because the species, few as they are, have been much confused. Hewitson described together under *leucyania* the male and female of two very different species, and Aurivillius, recognising this mistake, created a new species for the female, which is finally proved by W. A. Lamborn's material to be the hitherto unknown female of Holland's *mirifica.* The want of a proper understanding of the true relationships has been principally due to the great rarity of the specimens.

1. *Euliphyra leucyania,* Hewitson (see the accompanying Plate XXVII, figs. 1–4). First described under the genus *Liphyra* in Trans. Ent. Soc., 1874, p. 355, and afterwards in Ill. D. Lep. Suppl., 1878, p. 34 male, p. 35 female. Hewitson represented in fig. 2 of his Plate V b, the underside of the male and in fig. 1 the upper side of the female. As Aurivillius showed in "Rhopalocera Aethiopica" 1898, the female is an entirely different species from the male. The locality quoted by Hewitson in both publications is Old Calabar, but his two specimens in the British Museum are labelled Sierra Leone. Appended to the description in Ill. D. Lep. Suppl., published after Hewitson's death, is a note (p. 34) by the late W. F. Kirby, expressing the opinion that the reference of the species to the genus *Liphyra* was erroneous. The British Museum has since acquired an example of the true female of *leucyania.* The specimen bears the following data :—

"Ashanti, Obuassi (150 miles inland) 1902–3 (end of wet season and beginning of dry) G. E. Bergmar." At the same time undoubted evidence as to the sexes of *leucyania* is to be welcomed, and is provided by Mr. Lamborn's capture, on Feb. 6, 1911, in the forest 1 mile E. of Oni Clearing, of a pair *in cop.* The note with the specimens is as follows :—

"The damaged condition is attributable to the mode of capture. They were *in coitû* on a dry twig in the centre of a dead bush, and as I disturbed them they fell and separated, and I was obliged to scramble to catch them."

It will be seen by reference to Plate XXVII, figs. 1–4, that the condition of the butterflies is not so poor as might be inferred from the above note. The specimens have been compared with the male type and the female in the British Museum and they are closely similar—Lamborn's female having a slightly heavier dark marginal band.

2. *Euliphyra mirifica,* Holland (see the accompanying Plate XXVII, figs. 5–11). The male of this species was first described in "Psyche," 5, p. 423 (1890), again described and both upper and under surfaces figured in 1893 in Smith and Kirby's Rhop. Exot., 23, Lycaen. Afr., p. 89, t. 20, f. 11–12. The single specimen was bred by the Rev. A. C. Good on the upper waters of the River Ogové, Gaboon, having been "developed from 'a very singular chrysalis, short and thick, and unlike anything of the kind I have observed before, which was found upon the under side of a large leaf. It was black in color.'" ("Psyche," *l. c.*, p. 423.)

Aurivillius, having discovered Hewitson's mistake, referred to on p. 504 gave the name *hewitsoni* (Rhop. Aethiop., p. 286, 1898) to the female type of "*leucyania*" in the collection of the British Museum. I have compared both under and upper surfaces of Lamborn's 5 females with this type, and they are certainly the same species. The 3 males have been carefully compared by Mr. H. Eltringham and me with the excellent figures and description of Dr. W. J. Holland's male specimen in Rhop. Exot., and we have no doubt that they are the same species. Hewitson's female "*leucyania*" and Aurivillius' female "*hewitsoni*" become the female of Holland's *mirifica,* and Hewitson's original specimen, after serving temporarily as the female type of two species, is finally found to belong to a third.

Of Lamborn's 5 females, D (Plate XXVII, fig. 8) is almost exactly similar to Hewitson's specimen, and, like it, shows an exceedingly faint trace of a white mark below the cell of the hind-wing on the upper surface, corresponding to the position of the strongly marked white bar on the under surface. The trace is very faint and has not been reproduced in Hewitson's figure referred to above. The other 4 specimens—E, F, G, and H (Plate XXVII, fig. 9)—have the same faint mark rather more strongly emphasised, although it varies in the degree of development. Furthermore, in these 4 the white patch crossing the fore-wing is larger and less clouded over by dark scales in its central part. In the hind-wing patch these 4 females exhibit a slight approach towards *Euliphyra sjöstedti*, Aurivillius, described from the Cameroons in Ent. Tidskr., 16, p. 204, fig. 13, 1895, and almost certainly a Southern geographical race of *E. mirifica.*

A female *sjöstedti* from Ambriz, Angola, exists in the British Museum, and only differs from Lamborn's 4 females in the much greater development of the white patch of the hind-wing above: the patch on the fore-wing is similar, as also the pattern of the under surface.

The material described in the present paper seems to show beyond any reasonable doubt that at present only two species of the genus are known, together with a Southern geographical race of one of them.

Note on the genus Euliphyra *and its allies,*

by G. T. Bethune-Baker.

This genus has hitherto been placed among the *Lipteninae*; it does not however appear to me to have any relationship with that sub-family. If indeed it has any near connection with another genus, I should with little doubt ally it, as Hewitson did, with *Liphyra brassolis,* Westw. The shape of the wings is very similar,* whilst the male armature, though not like that of *brassolis,* is yet nearer to it than to any other species that I know. Prof. Poulton, having allowed me to dissect one of the Oxford specimens of *Euliphyra,* has enabled me thus to arrive at this conclusion. The clasps are quite small proportionately, they are somewhat oval with a longish angulated process at the apex. The Saccus (*i. e.* the lowest hindermost basal part of the girdle) is large and broad, whilst the girdle is somewhat slight in structure, the tegumen and the falces are very large and copious,

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* There is also a remarkable resemblance between certain features of the pattern of the hind-wing under surface, and the fact that the larvae of both live in the nest of the same species of ant *Oecophylla smaragdina.*—E. B. P.

EXPLANATION OF PLATE XXVII.

The species of the genus *Euliphyra*, Holland (pp. 450–6, 504–12). All the figures are slightly below the natural size.

FIG. 1. *Euliphyra leucyania*, ♂: captured, *in coitû* with the ♀ represented in figs. 3 and 4, in the forest 1 mile E. of Oni, Feb. 6, 1911 (pp. 504–5).

2. Under surface of the above ♂.

3. *Euliphyra leucyania*, ♀: captured *in coitû* with the ♂ represented in figs. 1 and 2.

4. Under surface of the above ♀.

5–11. *Euliphyra mirifica* bred in June and July 1912, from larvae or pupae found in or near nests of the ant *Oecophylla smaragdina* r. *longinoda*, in the forest near Oni. Full data will be found on pp. 455–6.

5. *E. mirifica*, ♂ 818 A.

6. ,, ,, ♂ 818 B: under surface.

7. ,, ,, ♂ 818 C: under surface.

8. ,, ,, ♀ 818 D: the pattern of the specimen here figured is nearly identical with that of Hewitson's type of the ♀ "*leucyania*" and of Aurivillius' ♀ *hewitsoni*.

8A. Pupa-case of above ♀. The expanded sucker-like base is distinctly shown.

9. *E. mirifica*, ♀ 818 H: the pattern of the under wings exhibits a slight approach towards that of the ♀ *E. sjöstedti* (pp. 505–6): the pattern of the upper wings is similar to *sjöstedti*.

10. *E. mirifica*, ♀ 818 F: under surface.

10A. Pupa-case of above ♀. The anterior part of the case still lies within the dorsally cleft larval skin.

11. *E. mirifica*, ♀ 818 E: under surface.

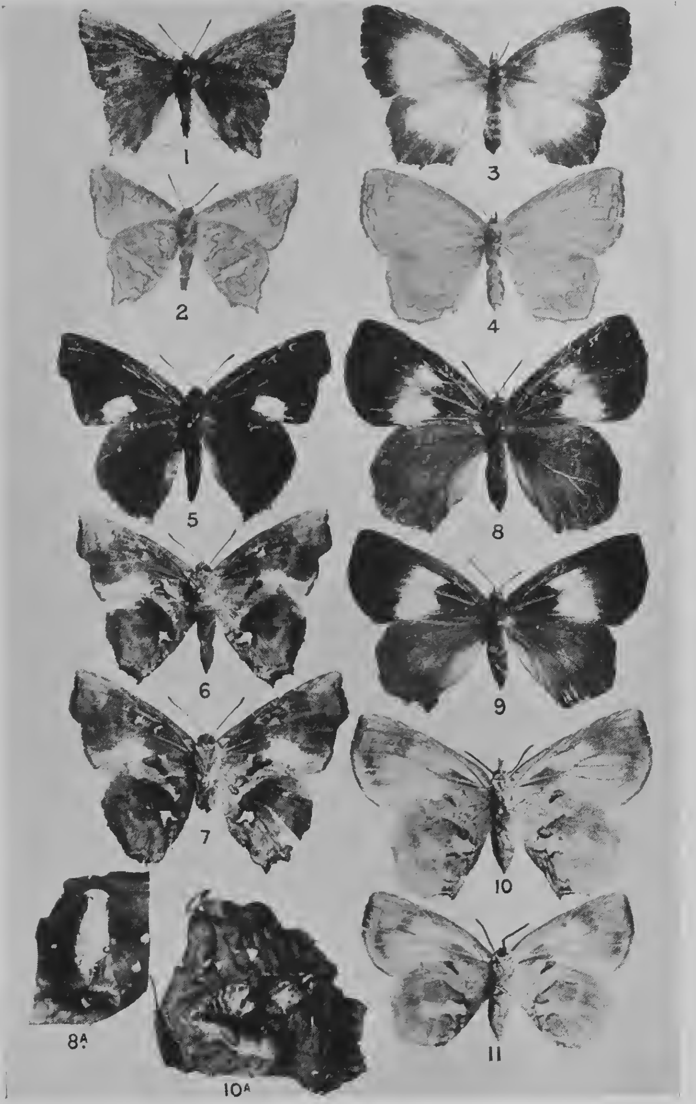

Photo., A. Robinson. *C. Hentschel.*

(*Slightly below natural size.*)

Euliphyra leucyania (figs. 1–4) and *E. mirifica* (figs. 5–11) from the Lagos district: W. A. Lamborn (1911–12).

the former being projected hindwards, that is towards the head of the insect, much more than forwards, the front line being straight, the dorsal apex being projected forwards suddenly but slightly, the dorsal apex itself being slightly but evenly excised: the hinder part is deeply hollowed out below the dorsal area, and projected backwards to form a blunt point in the centre of the dorsum: the falces are socketed on to the tegumen on the very front line, they are very large and strong, angled at a third from the socket and then curved forwards, the apical fifth being suddenly reduced so as to form a moderately fine tip. The aedoeagus is of moderate length, short for the size of the insect, of nearly uniform width, with the apical orifice arched, extending from the upper side of the tube, which is slightly lipped, to the under side, which is rounded off. This genus and *Liphyra* do not appear to me to be nearly allied to any other Ruralid group with which I am acquainted, though their male armature quite definitely shows that they belong to it. It may prove to be that they should form a small section of their own, in which case the most appropriate name would be the "*Liphyrinae*," in which I should also include *Aslauga*. The neuration of *Liphyra*, *Euliphyra*, and *Aslauga* is *very* close, the general shape of the wings is analogous, the life-history of each group is quite specialised. Mr. Lamborn speaks of the resemblance between the larvae of *Aslauga* and *Euliphyra* (p. 451), and both are animal feeders. The legs of *Aslauga* and *Liphyra* have a quite unusual similarity, and I fancy the palpi are also very similar and so are the antennae.

Note on the Structure of the Fore-legs in certain Lycaenidae by H. Eltringham.

As a rule the fore-feet of *Lycaenidae* furnish an easy method of distinguishing between the sexes, but in the genus *Aslauga*, as noted by Schatz and Röber, the male fore-feet are not distinguishable from those of the female, at least by ordinary methods. The male tarsus is quite definitely five-jointed, and the terminal joint is provided with two claws, a pulvillus, and paronychia. In the case of *Aslauga lamborni* a properly prepared microscopic preparation shows a difference between the male and female fore-feet, a difference which consists in the fact that in the male the terminal joint is much swollen, whilst the corresponding joint in the female, though of about the same length, and thicker than those which precede it, is nevertheless not so stout as in the male.

The persistence of the five-jointed, double-clawed tarsus in *Lycaenidae* occurs in other genera than *Aslauga*. The condition is found in *Arrugia*, *Theclopsis*, and *Euliphyra*. In *Arrugia basuta*, Trim., the femur of the male fore-leg is of a peculiar shape, having on the under side a pointed process of the chitin followed by a secondary smaller projection nearer the tibial joint. There is a mere indication of a similar structure in the female. The tarsi are not distinguishable in the two sexes, and in both the joints are equally spine-bearing. The paronychia are remarkable in appearing to be double on each side, possibly they are merely bifurcated. In *Euliphyra mirifica* there is no difference between the tarsi of the two sexes, except that in the female the claws are rather better developed.

Of *Theclopsis* I have been unable to secure an example for examination, but Godman and Salvin state that there are no paronychia. Preparations of the fore-feet of *Liphyra brassolis*, from specimens kindly furnished by Mr. Bethune-Baker, show that they are alike in the two sexes. In the male one of the claws seems rather less rounded than the other, but a series would be required to show whether this is a constant feature. The pulvillus is well developed, but there appear to be no paronychia.

The genera *Aslauga*, *Liphyra*, and *Euliphyra*, more especially the two latter, may be regarded as closely allied, but *Theclopsis* and *Arrugia* are widely separated from them and from each other, and the persistence of the five-jointed male tarsi must apparently be regarded as an independent survival.

III. *The Larva of* Euliphyra mirifica. By HARRY ELTRINGHAM, D.SC., M.A.

PLATE XXVIII.

Two spirit specimens of this remarkable Lycaenid larva, together with several larval and pupal skins have been kindly handed over to me by Prof. Poulton for examination.

I have endeavoured to illustrate the larva and some of its special features on Plate XXVIII, though I have found the correct delineation of its shape and markings peculiarly difficult, and the figures are scarcely so satisfactory as I could wish.

The specimens are about 20 mm. in length, and the dorsal and lateral views present an appearance recalling that of a mollusc rather than of a lepidopterous larva. The ground-colour is brownish ochreous, and there are several irregular markings of a rich umber brown. The general appearance from a dorsal view may be gathered from fig. 1. The lateral portion of the larval skin is extended and modified into a kind of mantle, the edge of which touches whatever the larva may be resting upon. From the edge of the mantle, the sides, which present an irregular and wavy surface, slope up to the dorsal area, along the whole length of which is a deep groove bounded on each side by a hard chitinous ridge, the latter, except at the extremities, being thrown into a series of deep curving folds. This dorsal groove curves down to the mantle edge rather abruptly at the hinder end but more gradually at the anterior extremity. Round the edge of the mantle are twenty-four dark brown spots, many of which are extended towards the dorsal region as irregular marks, and between these markings there are sometimes smaller spots of the same colour. On each side there are nine spiracles. The first lies just above the second dark spot of the mantle edge, the second is above the fourth spot, and the remainder correspond in position to the mantle spots beneath them. The third is placed very far up the side, the fourth a little lower, and the remainder still lower and in a nearly straight line.

The whole structure of the exposed portion of this remarkable larva is profoundly modified, presumably as a protection against the attacks of the ants by which in life it is surrounded. The entire skin is covered with thick chitinous plates which are irregularly radiate, and have sloping edges. The projections of these plates interlock with the lateral cavities of those adjacent, and the appearance under a high power is not unlike that of a complicated armour sheet of cog-wheels. Such an arrangement doubtless provides a very efficient protective covering with a maximum of flexibility. One of these plates is shown highly magnified at fig. 7, but they vary considerably in size and in the extent to which the edges are sloped. Further microscopic examination shows that the brown markings on the larva are caused by the presence of small brush-like chitinous tufts, fig. 8, one of which arises from the socket in the centre of each chitinous plate. In the unpigmented parts of the skin, from which these tufts are absent, the plates still have the sockets, so that at one period of its evolution the larva probably had the tufts or at least some scale-like growth on every plate. Here and there in the armour, especially (probably exclusively) * on the pigmented areas, there are small round openings, the edges of the adjacent chitinous plates being neatly hollowed so that each forms its respective part of the circle. Possibly these apertures are the external openings of glands, though I have as yet no proof of this. If, as I think, they are confined to the pigmented areas, this would probably account for the correlated presence of the brush-like tufts, which may either protect the openings, or, as Prof. Poulton has suggested, hold some attractive secretion prized by the ants.

Fig. 5 shows a portion of the margin of the mantle. The extreme outer edge is armed with a regular fringe of flat chitinous projections, their bases furnished with interlocking processes. On the upper side of each projection there is a thin scale, very narrow at its socket but increasing outwardly to about the same width as the projection on which it lies. The purpose of these scales is not very obvious, but possibly they may have a tactile function. Within the peripheral fringe so formed there is a row of thick elongated chitinous plates, the edges of

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* The openings described can be seen only in a carefully made microscopic preparation, and proof that they occur on the pigmented areas alone could only be obtained by making preparations of the skin of the entire larva.

which are provided with somewhat irregular interlocking processes. One of these plates is shown highly magnified at fig. 6. Each has a scale-socket, but, apparently, does not bear either a scale or a brush-like tuft.

Fig. 9 shows one of the spiracles. Most, if not all, of these have the openings represented on the plate, although it is sometimes difficult to be sure of the presence of all three. Protection is afforded by stiff pointed hairs, for the most part curving inwards towards or over the spiracular orifices. Finally, the hard chitinous ridges of the dorsal groove are armed with very short hook-like spines and there are a few spines or hairs on the underside of the mantle edge, so arranged as to preclude entry if the mantle were raised at any part.

On turning the larva over its lepidopterous character becomes more evident (see fig. 3). The head, three pairs of true legs, and five pairs of prolegs can now be seen. The true legs seem to be progressively slightly larger as we proceed backwards, whilst the last pair of prolegs are much smaller than the remainder. The prolegs are of what Dr. Chapman has described as the "Macro" type, having hooks only on the inner margins of the feet.

The head calls for special remark, owing to its modification in adaptation to the habits of the species. It is elongated and somewhat conical in form, and when withdrawn there is round the base a deeply invaginated fold of the cuticle. At fig. 10, I have prepared a semidiagrammatic illustration of the anterior portion viewed from beneath, to show the mouth parts, etc., though it must be understood that in the actual specimen the parts are all very small and close together, and cannot be distinguished so easily. There are six ocelli situate at *o*, four of which are anterior and lie in a small semicircle, the remaining two being rather more posteriorly placed. The antennae, *a*, are placed laterally just above the labrum, *l*, and beneath the latter, and in a dorsal view concealed by it, are the mandibles, *md*. These have four ridge-like teeth. The maxillae, *m*, have two large lobes each with two small points, and in the actual specimen lie close together, forming what looks like a pointed organ projecting from beneath the labrum, when viewed from above. There are large maxillary palpi, *mp*, and the labium, *lb*, is long and somewhat pointed, and has on it a small papilla, possibly a tactile organ. There is some evidence of a second and smaller papilla not shown in the drawing. As already stated the mouth parts are exceedingly small and difficult to make out distinctly.

At fig. 4, I have shown the larval and pupal skins as seen after the emergence of the butterfly. The pupa is attached in a peculiar way to a leaf, its sucker-like extremity being spread out and apparently cemented down. It will be noted that the larval skin is not completely shed, but has been split open on the exposure of the pupa, afterwards remaining in this expanded condition. Viewed from the other side the empty shells of head, feet, etc., are easily seen.

This interesting larva resembles in some respects that of the Australian *Liphyra brassolis* described by Dr. Chapman.* Both the specimens of *E. mirifica* sent by Mr. Lamborn are about the same size, so that I am unable to compare two stages of its growth, but evidently in *L. brassolis* the form in an earlier stage differs from that at a later period. Through the kindness of my friend Mr. G. T. Bethune-Baker, I have had an opportunity of examining larvae of this species. The cuticle is not provided with nterlocking plates, but is covered all over with chitinous tubercles, and at the edges of the mantle is provided with numerous short setae. There is no dorsal groove and the cuticle is not thrown into ridges. As Dr. Chapman has stated, the spiracles are "minute holes without marginal structure." I have not been able to examine the mouth-parts, but they are evidently larger than in *Euliphyra*. The antennae are certainly longer and more conspicuous, and the jaws are more adapted for piercing and tearing. Dr. Chapman describes a peculiar modification of the prolegs which is not evident in *Euliphyra*.

A further interesting point of comparison is that whilst in *E. mirifica* the pupa is formed half out of the larval skin, in *L. brassolis* it remains inside the larval cuticle, the latter forming a puparium like that of many Diptera.

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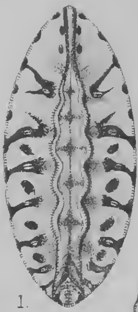
* *Entomologist*, p. 225, 1902. I am indebted to Commander J. J. Walker for this reference.

EXPLANATION OF PLATE XXVIII.

FIG. 1. Larva of *Euliphyra mirifica* as seen from above. × 2¼.

2. Ditto, as seen from side. × 2¼.
3. Ditto, as seen from below. × 2¼.
4. View of larval and pupal skins as they appear after emergence of imago. Note peculiar sucker-like attachment of pupa to its support, and the split larval skin remaining *in situ*. × 2¼.
5. Portion of " mantle " edge of larva showing arrangement of chitinous plates, etc. × 33.
6. One of the chitinous plates of the second row of the mantle edge. × 230.
7. One of the chitinous plates which cover the general dorsal surface. × 650.
8. One of the chitinous tufts which are attached to the pigmented portions of mantle. × 650.
9. A spiracle. × 50.
10. Semidiagrammatic view of extremity of head, arranged to show mouth parts; viewed from below. × 50.

(*a*) Antenna.
(*l*) Labrum.
(*m*) Maxilla.
(*lb*) Labium.
(*md*) Mandible.
(*mp*) Maxillary palp.
(*o*) Position of ocelli (these are not visible from a ventral view).



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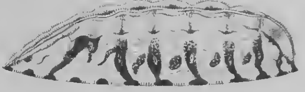

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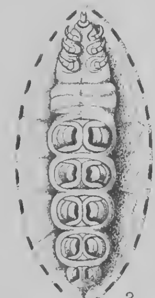

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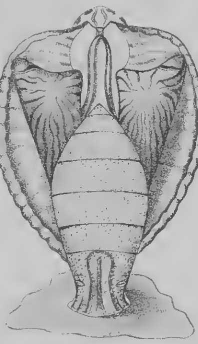

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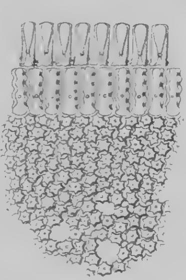

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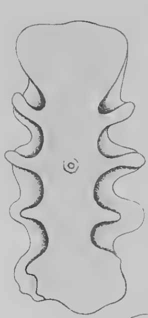

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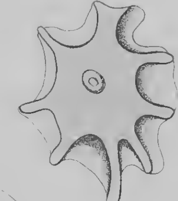

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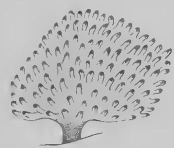

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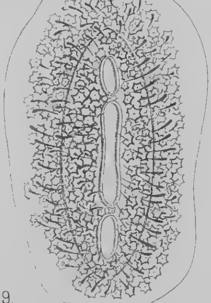

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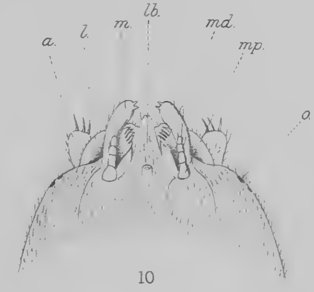

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H. Eltringham del.

West, Newman lith.

LARVA OF EULIPHYRA MIRIFICA.

IV. *Descriptions of two new* Tineina (Lep.) *from the Lagos District*. By J. HARTLEY DURRANT.

TINEINA.

AEGERIIDAE.

Tinthia, Wkr.

Tinthia lambornella, sp. n.

Antennae and *Palpi* (broken). *Head* and *Thorax* blue-black (the head much denuded). *Fore-wings* and cilia blue-black, without markings or hyaline spaces; somewhat more purplish on the underside than above. *Exp. al.* 28 mm. *Hind-wings* sooty black, with a hyaline space entirely filling the cell and extending somewhat beyond, the extension projecting further between veins 3–4 and 6–7 than between 4–5, thus ending in lunate form beyond the discoidal; between the upper anal and the cubitus the entire space is hyaline to beyond half the length of vein 2, the space between 2 and 3 appearing as a somewhat conspicuous intrusive black triangle; cilia sooty black; underside purplish black, with strong cupreous reflections, especially below vein 2 and toward the dorsum. *Abdomen* and *Legs* blue-black; hind tibiae roughened with scales at the spurs.

Type. ♀ (6790 Drnt. Det. 1912), *Oxf. Univ. Mus.*

Hab. AFRICA, W.—Oni, near Lagos. The unique specimen bred by W. A. Lamborn in 1912.

See also p. 493.

TINEINA.

TORTRICIDAE.

Tortrix, L.

Tortrix callopista, sp. n.

Antennae dark leaden grey, somewhat tinged with ferruginous. *Palpi* and *Head* ochreous. *Thorax* dark leaden grey, longitudinally striped with ferruginous.

Fore-wings leaden grey, ornamented with two transverse and four longitudinal vermilion stripes; the costa irregularly margined throughout with ochreous, commencing at the base, almost on the dorsum, and continued narrowly along the termen, but expanding above the tornus into an almost circular blotch and ending in a large pretornal triangular patch—these ochreous spots are more or less suffused with blackish, and five or six blackish spots occur along the costa; before the middle of the wing the ochreous costal colouring blends with a transverse vermilion fascia, slightly angulate on the cubitus, and there is a somewhat conspicuous ochreous triangular encroachment on the leaden ground-colour before the apex; parallel with the upper edge of the pretornal patch is a conspicuous vermilion length-streak, with another, somewhat bowed, midway between it and the costa; near the middle of the base is a short longitudinal vermilion streak, and below it a longer one reaches to a fasciaform stripe of the same colour, almost erect from the dorsum, but before reaching the radius gradually curving round, becoming nearly parallel with the costa, and ending abruptly before the base; cilia (injured) ochreous, apparently tipped with greyish. *Exp. al.* 9 mm. *Hind-wings* fuscous; cilia pale at the base, with a dark dividing line. *Abdomen* fuscous. *Legs* greyish ochreous.

Type ♀ (6866 Drnt. Det. 1913), *Oxf. Univ. Mus.*

Hab. AFRICA, W.—Oni, near Lagos. The unique specimen bred by W. A. Lamborn, Jan. 27, 1912, from a carnivorous larva which fed upon *Stictococcus sjöstedti.*

Closely allied to *Tortrix viridis*, Wlsm. (Tr. Ent. Soc., Lond. **1891**, 68–9, Pf. **3**·4), but in general pattern even more like *Epagoge albardana*, Snln. (Wlsm. Tr. Ent. Soc., Lond. **1891**, 69–70, 131, Pf. **3**·5). The type, which is somewhat injured, has been described at the request of Prof. Poulton to accompany Mr. Lamborn's observations upon the life-history of the species as recorded on pp. 493-4.

V. *Homoptera* (Membracidae *and* Jassidae) *collected in the Lagos district by W. A. Lamborn.* By W. L. DISTANT.

Fam. MEMBRACIDAE.

NEOXIPHISTES, gen. nov.

THIS genus possesses all the characters of *Xiphistes* (found in both the Oriental and Ethiopian Regions), but differing in the length of the posterior pronotal process, which is very long, considerably passing the apex of the tegmina. In *Xiphistes* it about reaches the apex of the interior margin of the tegmina.

Type. Neoxiphistes lagosensis, Dist.

Neoxiphistes lagosensis, sp. n.

Piceous; the central pronotal ridge, apices of the pronotal angles, and about apical half of the posterior pronotal process, castaneous; tegmina subhyaline with the venation black; pronotum finely rugose, centrally strongly longitudinally carinate, anterior angles robust, tricarinate, obliquely divergent, about as long as breadth of pronotum at their bases, beyond the central longitudinal carination are shorter and less pronounced carinations proceeding from the outer and inner basal margins of the produced angles: the posterior pronotal process is nearly as long as the whole body including the tegmina, and extends considerably beyond the tegminal apices, it is also tricarinate or three-cornered; legs brownish-ochraceous, femora (excluding apices), and the tarsal claws, black.

Long. incl. lat. pronot. angl. and post. pronot. proc. 8 to 10 mm.

Hab. Oni, near Lagos (*W. A. Lamborn—Oxford and Brit. Muss.*).

See also p. 497.

Genus LEPTOCENTRUS.

Leptocentrus, Stål, Hem. Afr., iv., pp. 87 and 90 (1866); *id.* Öfv. Vet.-Ak. Förh. 1869, p. 281; Dist., Faun. Brit. Ind., Rhynch. Hom., iv., p. 28 (1907).

Rabduchus, Buckt., Monogr. Membrac., p. 251 (1903).

Leptocentrus altifrons.

Centrotus altifrons, Walk., List. Hom., ii, p. 608 (1851).
Centrotus Bos, Sign., in Thoms., Arch. ent., ii, p. 336 (1858).
Leptocentrus Bos, Stål, Hem. Afr., iv, p. 90 (1866).
Rabduchus gnomon, Buckt., Monogr. Membrac., p. 251, Pl. lvii, figs. 4, *a*, *b*, (1903).

This species, which was found at Lagos by Mr. Lamborn, has had its nomenclature unduly complicated. Stål, at the time of writing his "Hemiptera Africana," ignored all the work of Walker, even to placing his species as synonyms of other species described subsequently (*supra*). Buckton has redescribed both genus and species. His types are now before me. The one figured by him (not this type) has the pronotal posterior process a little raised.

See also pp. 494–7.

Anchon decoratum, sp. n.

Head and pronotum black; pronotum with a central longitudinal castaneous carinate line and with a cretaceous sericeous line on each side behind and before the base of each lateral process, posterior pronotal process dark castaneous, sometimes black; scutellum more or less greyishly sericeous; tegmina black, sometimes very dark castaneous, a small pale spot near apex of clavus, and a large transverse subapical ochraceous spot extending about half across the apical area from costal margin; body beneath piceous, lateral margins of sternum greyishly sericeous; legs ochraceous or pale castaneous; pronotal lateral processes recurved and divergent, their apical areas moderately flattened and broadened a little but distinctly inwardly ampliate before apex which is acute, the posterior process is obliquely raised at base and there apically furnished with a short outwardly directed spine, then sinuately and obliquely directed to apex and to a little before tegminal apex.

Long. 5 to 5½ mm. Exp. pronot. proc. 4½ to 5 mm.

Hab. Oni, near Lagos; forest (*W. A. Lamborn—Oxford and Brit. Muss.*).

See also p. 498.

Anchon relatum, sp. n.

Closely allied to and resembling the preceding species *A. decoratum*, Dist., but differing in the following characters. The pronotal apices are considerably more acute and the apical areas are not ampliated inwardly; the apical area of the posterior process is concavely sinuate and its apex horizontal (in *A. decoratum* the apical area is a little convex and the apex depressed over the apical angle of the tegmen); the tegmina are dark castaneous, with the oblique apical area paler, the apical margin black, and with a somewhat large black spot beyond apex of clavus.

Long. 6 mm. Exp. pronot. proc. 5½ mm.

Hab. Oni, near Lagos (*W. A. Lamborn—Oxford Mus.*). See also p. 467.

BENINIA, gen. nov.

Face subtriangular, apically concavely excavate before clypeus; ocelli almost on a level with the upper margins of the eyes and about as far from each other as from eyes; pronotum shorter than the tegmina, without lateral processes, but centrally, anteriorly produced upward in an almost erect process, the apex of which is bilobed, the posterior process is long, somewhat slender, sinuately adpressed to the tegminal suture, its apex deflected, narrowly subacute and slightly passing the inner tegminal angle; tegmina extending beyond the abdominal apex, their apices subacute, their apical areas provided with apical and subapical cells; tibiae slightly dilated.

Allied to *Congellana*, Dist. (Div. *Hypsaucheniaria*), but differing in the completely distinct structure of the pronotal posterior process.

Type. B. lamborni, Dist.

Beninia lamborni, sp. n.

Body and legs dark castaneous; tegmina shining ochraceous, base narrowly suffused with castaneous; pronotum finely rugulose, longitudinally tricarinate on disk, central carination straight and continued along the posterior process, the outer carinations short and roundly posteriorly curved inward, the discal erect process apically obliquely transversely bilobed, each lobe upwardly convexly laminate with the margins distinctly paler, posterior process tricarinate.

Long. 7 mm.

Hab. Oni, near Lagos (*W. A. Lamborn—Oxford and Brit. Muss.*). The type and one paratype were captured on *Triumfetta cordifolia* in the forest ½ mile E. of Oni, Jan. 27, 1912, and two paratypes 1 mile E. under conditions otherwise the same.

See also p. 465.

AWANIA, gen. nov.

Body oblong-ovate; head with two prominent, porrect subacute tubercles at base of head just beneath the anterior margin of the pronotum, and above the ocelli which are about as far apart from each other as from eyes, the tubercles are very plainly seen from above; pronotum convexly gibbous, the lateral angles obsoletely subprominent, the central longitudinal carination acute and continued along the posterior process which is somewhat slender beyond the base, tricarinate, concavely sinuate, and extending beyond the claval apex of the tegmen, it is also well separated from the tegminal suture, its apex acute; tegmina more than twice as long as broad, with four long apical cells and two subapical cells; legs moderately long, the tibiae not prominently dilated, the posterior tibiae outwardly shortly, closely robustly serrate. Scutellum complete and visible beneath the raised posterior pronotal process.

I place this genus in my division *Gargararia*, and its principal characteristic is found in the porrect prominent tubercles at the base of head.

Type. *A. typica*, Dist.

Awania typica, sp. n.

Head, pronotum, scutellum, body beneath and legs black, the greater part of the intermediate tibiae and the basal areas of the tarsi, pale castaneous; tegmina shining pale ochraceous, the base and the venation black; head and pronotum subrugulose and coarsely punctate; the posterior pronotal process is also coarsely punctate on each lateral area; other structural characters as in generic diagnosis.

Long. 7 mm.

Hab. Oni, near Lagos, 1912 (*W. A. Lamborn—Oxford Mus.*). The unique type was the prey of an Asilid fly captured by Mr. Lamborn.

Fam. JASSIDAE.

Sub-family *BYTHOSCOPINAE*.

OSSANA, gen. nov.

Head with the vertex broad and narrow, including eyes which are broader than long, reaching the anterior angles of the pronotum but not so broad as the posterior pronotal angles, front including face almost or about as long as broad, ocelli on face between the eyes, nearer to eyes than to each other; clypeus slightly broadened posteriorly, its apex truncate; pronotum moderately convex, about three times as long as vertex and about as long as scutellum, anterior margin slightly rounded, almost truncate, posterior margin almost truncate, the posterior angles slightly roundly prominent; scutellum triangular, its apex acute; tegmina about twice as long as broad, passing the apex of abdomen, apical areas three; legs of moderate length, posterior tibiae long, slightly curved, strongly spinulose.

Type. *O. bicolor*, Dist.

Ossana bicolor, sp. n.

Head, pronotum, and scutellum shining black; body beneath, legs, and tegmina ochraceous; vertex of head in some specimens entirely black, in others more or less suffused with ochraceous; scutellum in some specimens entirely black, in others with the anterior margin more or less suffused with ochraceous; pronotum finely transversely wrinkled; scutellum distinctly transversely incised before apex; other structural characters as in generic diagnosis.

Long. 4 mm.

Hab. Oni, near Lagos (*W. A. Lamborn—Oxford and Brit. Muss.*).

See also pp. 470–1.

Nehela ornata, sp. n.

Black; posterior margin of pronotum, a curved transverse fascia near apex of scutellum, two short discal transverse lines crossing tegminal suture—one before and the other near middle—a spot on suture a little before apex, and the legs pale ochraceous; anterior and intermediate tarsi, posterior tibiae, and apices of posterior tarsi, black; head with the vertex short, as broad as the anterior margin of the pronotum, rounded, slightly angulate; face dilated, subtriangular, apex produced, laterally before eyes, sinuate; ocelli between eyes, about as far apart from eyes as from each other; pronotum very finely transversely wrinkled.

Long. 4 mm.

Hab. Oni, near Lagos (*W. A. Lamborn—Oxford and Brit. Muss.*).

This species differs from the type of the genus described by Buchanan White from the Island of St. Helena in having the vertex of the head more rounded and less angulately produced. I have not considered that this is alone, at least for the present, sufficient to justify the proposition of a new genus, though the hemipterous fauna of St. Helena has not hitherto been shown to have much affinity with that of tropical Africa.

See also pp. 459–67.

VI. Homoptera (Psyllidae *and* Coccidae) *collected in the Lagos District by* W. A. Lamborn. By Prof. R. Newstead, F.R.S.

Plate XXIX.

PSYLLIDAE.

Rhinopsylla lamborni, sp. nov.

Length 3·9–4·2 mm.; greatest width of thorax, 1·4–1·50 mm.; width at vertex of head, ·58–·75 mm.; length of fore-wing 4·5–5 mm.

Head slightly birostrate in front; face lobes wanting; eyes hemispherical, prominent; wings with the upper and lower branches of the cubitus very long, stigma wanting; hind tibiae in ♀ (fig. 1*d*) and middle tibiae in ♂ (fig. 1*e*) very strongly pectinated distally; meso-sternites with a lateral and distal horn-like tubercle. General colour ochraceous buff; thorax striped.

Female.—*Head*, inclusive of the eyes, as broad as the thorax; posterior margin of vertex arcuate; front with a sharply defined median suture on either side of which is a deep punctate depression. *Antennae* long and slender, of ten segments, the third incrassate and strongly punctate when seen in optical section in cleared specimens. *Thorax* slightly arched and finely punctate; pronotum clearly defined and normally not depressed below the head. *Abdomen* markedly attenuated distally; pygidium (fig. 1*a*) with the circumgenital glands (fig. 1*b*) arranged in curiously contorted double lines. *Legs* with the hind tibiae very strongly pectinated, the teeth black, and each with a faint lateral tooth. *Wings* (fig. 1*c*) hyaline, nearly twice as long as broad, costa strongly arched; there is a small infuscated, submarginal, spinose area between the radius and the upper fork of the upper cubitus, and a similar marginal infuscation between the four succeeding veins; branches of the upper and lower cubitus very long. *Colour* ochraceous-buff or ochraceous; pronotum with a well-defined and relatively broad dark-brown margin;

thorax in front of the transverse suture with four dark-brown or blackish stripes of which the median pair are the broadest; the median pair of stripes behind the suture pale brown; the second pair of stripes dark-brown or blackish, narrowly ovate and attenuated anteriorly; the third pair of stripes are also very broad but of the same colour as the ovate ones.

MALE, closely resembling the female in colour and markings. *Genital armature* (fig. 2) with the superior claspers widely divergent *dorso-ventrally*, with the inner lateral margin strongly concave, and the outer lateral margin angulate near the middle, tips bluntly rounded. *Vesica* (fig. 2*b*) very short and arising from an almost complete chitinous ring through which the penis (fig. 1*c*) passes. The latter curved suddenly downwards and forwards, base bulbous; inferior claspers (fig. 2*d*) wide and broadly rounded distally, lower margin strongly concave; median process (fig. 2*e*) obliquely truncate distally.

Taking all the salient characters into consideration it would seem that this insect agrees best with the genus *Rhinopsylla*, Riley, as defined by Crawford * in his article on the American Psyllidae; though, as this author has pointed out, this genus may eventually prove to be identical with the European *Bactericera*, Puton. The head of *R. lamborni*, Newst., is not, however, so strongly birostrate as in the American species, but this character varies to a somewhat marked extent even in the few known species described from that country.

I have much pleasure in dedicating this insect to its discoverer. Described from 6 ♂♂ and 8 ♀♀. The type male and female bear the following data :—" A in cop. B. B in cop. A. Feb. 26, 1912. Lagos, 70 m. E. nr. Oni clearing. Dry S. c. Dec. 8–11 to Mch. 23, 1912. W. A. Lamborn." The paratypes (now mounted in Canada balsam) bear the record :—" Fr. mass like 61. Feb. 25, 1912. Lagos, 70 E. Oni clearing. Dry Seas. Dec. 8–11 to Mch. 23, 1912. W. A. Lamborn."

See also p. 498.

COCCIDAE.

Stictococcus sjöstedti, Cockerell.

Stictococcus sjöstedti, Cockerell, Canad. Entom., vol. xxx, p. 64 (1903).

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* " Pomona Coll. Journ. of Ent.," vol. iii, p. 440 (1911).

Stictococcus sjöstedti, Newstead, Journ. Econ. Biol., vol. ii, p. 149 (1908).

This remarkable Coccid is one of the recognised cocoa pests of Western Africa. I have already noted * that this species and also *S. formicarius*, Newst., are preyed upon by Lepidopterous larvae, though I was unable to determine the group to which the latter belonged.

In examining the material kindly furnished by Prof. E. B. Poulton, I have discovered that the larvae of *S. sjöstedti* are undoubtedly dimorphic. In one of the females there is one embryo larva of each sex still remaining in the body of the parent, so that there can be no possible doubt as to the authenticity of this record. This discovery clears up the marked discrepancies existing between the descriptions of the larvae given by Prof. Cockerell and myself, respectively. Now that I have the larvae of both sexes before me it is perfectly obvious that the larva described by myself was that of the male, while that described by Cockerell was undoubtedly that of the female. The differential characters may be briefly summarised as follows :—

	Male larva.	*Female larva.*
Mouth . .	? Obsolete.	Normal.
Anal orifice .	Anal.	In the middle of the back.
Marginal spines	Of great length.	Short, of two types: one broad and dactyliform, the other curved and serrated.

The examples in question are so much distorted in the preparation that it is impossible to add any further particulars at this juncture; neither can I be quite certain as to whether there is a mentum present in the male larva or not, but as there is no trace of the buccal filaments I assume that the mouth is obsolete, as is certainly the case with the male larva of *S. dimorphus*,† Newst. Thus we now have two well-marked instances of sexual dimorphism in the larvae of the *Coccidae*, both belonging to the genus *Stictococcus*: characters which are not only very remarkable but quite unique and unprecedented in this group of insects.

See also pp. 447–50, 460, 462, 491–2.

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* "Journ. Econ. Biol.," vol. v, p. 22.

† "Bull. Ent. Res.," vol. i, p. 63, fig. 2 (1910).

Dactylopius longispinus, Targioni-Tozzetti.

A common and widely distributed pest. Fernald* and many other students now refer *Dactylopius*, Targ.-Tozz., to the genus *Pseudococcus*, Westwood. I have thought best to retain the name which has been so long in use, so as to avoid confusion in this communication.

See also pp. 446, 475.

Dactylopius virgatus, var. *madagascariensis*, Newst.

The specimens are all in very bad condition and are denuded of their characteristic covering; but there can, I think, be little doubt as to the correct identity of the species as all the morphological characters agree with typical examples of this Coccid. This insect seems to have established itself in other parts of Western Africa, as I have recently received examples from Illorin, Northern Nigeria, also on "Pride of Barbados," *Caesalpinia pulcherrima*, Sw.

See also p. 475.

Lecanium punctuliferum, var. *lamborni*, n. var.

Female, adult, ovate, moderately convex, margin broadly flattened though in some individuals it is slightly reflexed; integument apparently strongly rugose at the margins; but is so thickly coated with dirt, that the true texture is practically obliterated. *Colour* (dead examples) pale brownish-ochraceous, dusky greenish-yellow, reddish-brown or chocolate-brown. *Antennae* of seven segments of which the third and seventh are the longest. *Legs* well developed; tarsus exclusive of the claw nearly as long as the tibia. Scales of *anal operculum* rounded distally; base much longer than distal margin. *Derm cells* small, oval, widely separated and visible only towards the margin. *Stigmatic cleft* extremely shallow; spines three, the median one of great length. *Marginal* spines long fimbriated distally; short simple spines occur between the larger ones, sometimes alternately.

The young females are much paler than the adults—varying between yellowish-buff and reddish-buff; two examples also exhibit traces of lateral black markings, and in one of them these coalesce posteriorly and form an interrupted U-shaped line. The *anal operculum* in the young females is markedly attenuated and very narrow. The *antennae* are similar to those of the adults, but in one example these organs are asymmetrical, the right antenna

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* "Cat. Coccidae of the World," p. 104 (1903).

being short, stumpy and of five segments; the other normal, consisting of seven segments.

This insect differs from *L. punctuliferum*, Green,* in the greater length of the tarsus, in having seven instead of eight segments to the antennae, in the sparseness of the oval derm cells, and in the form of the anal operculum.

With the limited supply of specimens it is impossible to say if there is any variation in the character of the antennae; but so far as one can judge this insect appears to be a well-marked race of *L. punctuliferum*.

All the adult female Coccids had evidently been protected by ants, as portions of the coverings or "sheds" are still attached to the twig and partly cover the little colony of Coccids. On tearing out a small fragment of one of these coverings one finds that it is composed largely of finely comminuted vegetable detritus, among which there are fragments of bud-scales and numerous, unicellular, epidermal plant hairs; interspaced at rare intervals there are traces of the mycelium of a fungus. It is difficult to understand how this material is held together as there are certainly no silken threads employed in its formation; moreover, it has no constituent readily soluble in water, so that, apparently, no gum-like material is used in cementing the fragments of leaves together.

Green (*l. c.*) says that *L. punctuliferum* is "attended by ants (*Oecophylla smaragdina*), which had fastened the leaves (of the food-plant) together, forming a shelter." Wheeler,† in discussing the relation of ants to plant-lice scale insects and caterpillars, gives an illustration of a "carton aphid tent built by *Cremastogaster lineolata*" which is of similar form to those built over the colonies of the *Lecanium* herein described.

One of the co-type females of *L. punctuliferum*, var. *lamborni*, contains the pupa of a Chalcidid parasite, and another example *in situ* upon the stem of the food-plant has a small perforation in the dorsum indicating the escape of a similar or identical parasite.

See also p. 447.

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* "Coccidae of Ceylon," p. 205, pl. lxx, figs. 5–13 (1904).

† "Ants: Their Structure and Development," p. 341, fig. 205 (1910).

EXPLANATION OF PLATES XXVI–XXIX.

(*See Explanation facing the* PLATES.)

EXPLANATION OF PLATE XXIX.

FIG. 1. *Rhinopsylla lamborni*, Newstead; *a*, pygidium of ♀, ventral; *b*, circumgenital glands; *c*, wing; *d*, pectinated extremity of hind tibia of ♀; *e*, pectinated extremity of middle tibia of ♂.

2. *Rhinopsylla lamborni*, Newstead; male genital armature; *a*, superior claspers; *b*, vesica; *c*, penis; *d*, inferior claspers; *e*, median process.

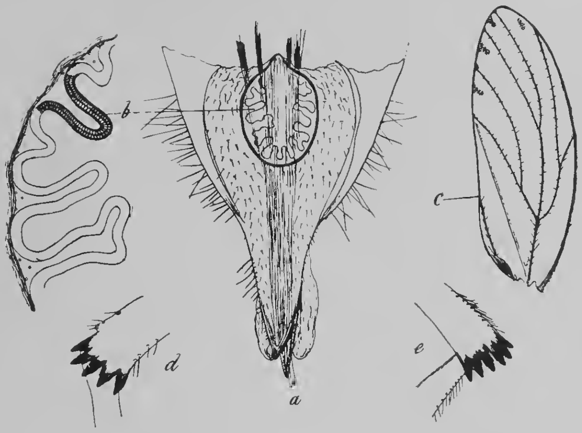
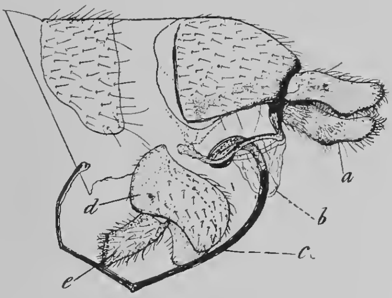


FIG. 1.



R. Newstead, del.

C. Hentschel.

FIG. 2.

RHINOPSYLLA LAMBORNI, *Newstead.*

3

XII. *Five Years' Observations* (1914–1918) *on the Bionomics of Southern Nigerian Insects, chiefly directed to the Investigation of Lycaenid Life-histories and to the Relation of Lycaenidae, Diptera, and other Insects to Ants.*

By the late CHARLES OGILVIE FARQUHARSON, M.A., B.Sc., Aberdeen. Edited, with a brief life of the author, by EDWARD B. POULTON, D.Sc., M.A., F.R.S., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford. With a systematic and descriptive Appendix by R. S. BAGNALL, G. T. BETHUNE-BAKER, Dr. T. A. CHAPMAN, F.R.S., J. E. COLLIN, J. HARTLEY DURRANT, F. W. EDWARDS, Dr. HARRY ELTRINGHAM, D.Sc., M.A., Prof. J. BRONTÉ GATENBY, D.Phil., D.Sc., Prof. R. NEWSTEAD, F.R.S., Prof. E. B. POULTON, F.R.S., Prof. F. SILVESTRI, Dr. J. VILLENEUVE, and Dr. JAMES WATERSTON, B.D., D.Sc.

[Read June 2nd, 1920.]

PLATES IX–XIX. TEXT FIGS. 1–6.

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Charles Ogilvie Farquharson, 1888–1918.

By Prof. E. B. Poulton.

The fine and accurate observer whose letters and collected material form the subject of the following memoir was born on February 13, 1888, on a farm at Murtle, in the valley of the River Dee, a few miles west of Aberdeen. At the age of about eleven he went to Robert Gordon's Secondary School, where it is remembered that he worked well and took a good place; also that country walks were a greater attraction to him than games.

In October, 1905, he entered the University of Aberdeen, at first as a student of English, Latin and Greek, but changing to Natural Science in July, 1907. His letters supply plenty of evidence that the two years at Classics had left a strong and lasting impression. Out of many passages I select the following because it also brings out his love for the insects he was studying. The name "*parsimon*," which filled him with horror, was given to a West African Lycaenid butterfly by no less an authority than Fabricius, the favourite pupil of Linnaeus.

"'*Parsimon*' calls only for compulsory Greek for science students: [see also p. 398]. There ought to be a sub-committee of the 'Entomological' for the protection of the good name of nice insects, with special reference to such fair masterpieces of Nature's handiwork as the Lycaenids. Yesterday I saw a beautiful 'Copper,' probably only a few hours after emergence [see p. 380]. It was simply too beautiful to capture. I hoped that one day I might breed a few out, to keep some and let the others away, just in case there might not be enough to keep the race going [Dec. 9, 1917]."

After graduating as M.A. in 1908, Farquharson continued his scientific work for the B.Sc. which he took "with special distinction in Botany," in 1911. He entered upon this science in April, 1908, and then first came under the influence of the great and inspiring teacher, the late Prof. James W. H. Trail, one who did not treat Botany as an isolated subject but always brought the relation between plants and animals before his pupils. Prof. Trail remembered that Farquharson, when a student, possessed "unusual power in distinguishing the essential from less important matters in each problem that presented itself to him, as well as in working out solutions to these problems, so as to make each addition to his knowledge a real gain" (C., p. 139).

Prof. Trail also told me that Farquharson was "one of the best among the many who have passed through our University; and I felt," he wrote, "no doubt as to the quality of the work that was done by him, for he was thorough and forgetful of self in whatever he undertook, and the love of natural science was inborn in him, along with exceptional ability."

For all his hard work and keen interest in many studies Farquharson entered with avidity into the literary and social life of the University, taking an active part in the Debating Society, the Sociological Society, of which he was at one time President, and editing and writing for "Alma Mater." His friends too "recall many long evenings in his company in bygone days, when a few kindred spirits were wont to meet to settle all the problems of the universe" (B.).

In 1911 Farquharson was appointed Mycologist to the Agricultural Department of Southern Nigeria—happy in finding a career in the one subject which attracted him most. Before starting, early in 1912, to West Africa, he spent some months of specialised study in London, chiefly at Kew. It was probably at this time that he came under the second great influence which affected his whole outlook. How much he owed to the late George Massee is best expressed in the words of one of his last letters.

"I ought to add," he wrote to Dr. A. W. Hill, F.R.S., on August 23, 1918, "that George Massee's economic-mycological outlook has influenced most things I have done, perhaps not as published, but in the intimate expression of his views that he used to give at Kew. Again and again I have wished he were alive. Kew wasn't the same place to me last time I was home" (D., p. 354).

The Agricultural Department, which, except for his visits to Agege and other places in Southern Nigeria and his leaves in the Old Country, was to be Farquharson's home for the rest of his life, is situated at Moor Plantation (480–580 ft.), about 4 miles west of Ibadan, and here the great majority of the observations recorded in this memoir were made. His first researches, upon the Mycetozoa, appeared in an important paper written in collaboration with Miss

G. Lister, the distinguished authority on the group (Journ. Bot., vol. liv, 1916, pp. 121–33, pl. 541).

Farquharson had been a year at Moor Plantation when he came under a third great influence, and one which was to determine the direction of his later researches; for, in May 1913, W. A. Lamborn, an extraordinarily keen and accurate observer of insect life, became his colleague as Government Entomologist.

How his interest came to be aroused is told in a letter written to me on February 10, 1914:—

"I have to thank you for your most kind and encouraging letter which I received by last mail and for the many kind references to myself in your letters to Dr. Lamborn. I greatly fear, however, that you are giving credit where very little is due. Perhaps he has not explained how I came to bring him in the specimens which he generously contributed in my name to the Hope Collection. In my spare time I was collecting some fungi for Kew and Myxomycetes for Miss Lister, and of course in passing I met with some insects that looked interesting which I took to Dr. Lamborn. Under the stimulus of his enthusiasm I became interested in the curious habits of many of the insects and wrote one or two notes at his suggestion.

"It is largely due to the Myxos that the work was done. One has to look rather closely for these, and the relatively gross, if I may so use the word, phenomena of insect life could hardly be overlooked. On Moor Plantation, I am happy to say, I have since the beginning of August found nearly thirty species of Myxos, nearly half of which are new African records. The dry season has stopped this work for the present and I have in consequence taken to the insects."

And later in the same letter, referring to the suggestion that he should join the Entomological Society:—

"There is no withstanding Dr. Lamborn, and under his inspiration I may manage to do something which will enable me with less unworthiness to join the Entomological."

Although Lamborn and Farquharson were only together for twelve months, the inspiration of which he spoke remained and grew with every fresh discovery and was strongest in the last year of his life. His original observations in this short period were described in eighty closely packed quarto pages, written between September 9, 1917, and August 31, 1918 (p. 401), just before he sailed in the ill-fated "Burutu." It is a pathetic thought that these pages in twenty separate letters, and all the packets of specimens illustrating them, should have arrived safely in England while the author was lost.

His consignments of rare and interesting specimens were so numerous that it was suggested that the museum would gladly bear the expense, but he at once replied: "I'll be only too pleased to send at my own charge. I simply wouldn't dream of anything else. . . . I'm practically a non-smoker and a most temperate person too, and I *must* help the revenue somehow. . . . If what I manage to do would help to clear up even a very small point of Lycaenid relationship I'd consider any personal outlay most amply and gloriously rewarded."

Thinking of all that he owed to Aberdeen, Farquharson was anxious to collect examples of butterfly mimics and their models for the Zoological Department of the University; for, as he wrote, they "might inspire some student to do a little as Lamborn did me."

The friend of whom he so continually spoke with gratitude has recalled memories of their year together at Moor Plantation:—

"I first met C. O. Farquharson in the spring of 1913 when I entered the Government service as Entomologist. He had completed his first tour of a year, and had just returned from leave.

"Our laboratories, under a common roof, adjoined; and a community of interest in scientific work soon put us on a very friendly footing. As a worker I found him most indefatigable. It was his practice, almost as soon as day broke, to walk round the experimental farm, searching for and examining fungi of economic importance. During the later official working hours of the day he devoted himself conscientiously and exclusively to the study of material gathered earlier, making microscope preparations, preparing cultures, and reading up original descriptions; for he had a sound knowledge of modern languages. In the early evening, when he might reasonably have rested, or at all events indulged in some physical relaxation, his untiring enthusiasm again led him forth, this time to explore the far wider field of the almost virgin bush near by.

"He was keenly interested in animated nature and from time to time had asked concerning the habits of the numerous insects he had seen. But his first active interest in Entomology was, I believe, awakened by the discovery of beetles in various instars in some of his beloved fungi, the Polyporeae. An examination of some Lamellicorn larvae in the fungi led to a discussion of the habits of the group as a whole, and the natural agencies which might limit the numbers of insects in general. He had not heard of the various parasites, or of the ways of the Fossorial wasps; and a long talk induced us to sit, as I well remember, being very contrary to my fixed habits in the Tropics, well into the small hours of the night.

"Of a romantic nature, he revelled in the study of the romance of insect life, and at about that time I was so fortunate as to throw some light on the value in sexual selection of the wonderful mandibular processes of the Eumenid *Synagris cornuta* Linn [Report, Brit. Assoc., 1913, p. 511]. Thereafter Farquharson vied with me in the study of the Hymenoptera, working still harder during leisure hours, and joining me in my laboratory after the evening meal, so that we could compare and discuss the results of excursions made together on Sundays, and independently on week days.

"The habits of Lycaenidae, the most interesting of all butterflies both as larvae and imagos, then claimed his attention: for I was able to show him various ant-attended and predaceous larvae, and therefrom originated the splendid new discoveries concerning the group with which his name must always be associated.

"Farquharson was a most versatile and widely read man. He had a sound knowledge both of French and German, and was familiar with the Classics, having a pleasing little habit of capping remarks, often in letters, with an appropriate quotation in Greek or Latin. He had in addition that broad general foundation of scientific knowledge which seems so especially to be built up by the teaching of the Scottish Universities, enabling him to turn with equal readiness to the study of the sciences both of Mycology and Entomology.

"His premature loss must be a bitter blow to Mycology, but, as a student of insects realises, especially to Entomology in the African Tropics, for far more investigation, on the West Coast particularly, is now called for to complete the various researches already initiated by him.

"The additional losses of C. Mason in Nyasaland, and of H. Dollman of N. Rhodesia, workers of promise, both through illness contracted while on duty, are a further setback to the advance of the science, inasmuch as, in spite of the vastness of the British African possessions, the number of enthusiastic workers is so very limited, the Governments not yet being alive, apparently, to the paramount importance of Entomological research.—W. A. L."

In his admirable letter to Dr. A. W. Hill (D.), Farquharson gives, as Prof. Trail wrote to me, "an exceptionally good statement of such work as fell to him and of how to face it," and the letter was reprinted in the "Aberdeen University Review" (E.) because Prof. Trail wished his students to read it.

Farquharson's main object in this letter was to emphasise the essential importance of understanding all that promotes the healthy life of the normal plant, and of looking, in the first instance, to the conditions of growth rather than to the *deus ex machinâ* of a parasitic fungus or insect enemy.

He believed "that every mycologist ought to be deprived of his microscope (and perhaps even of his pocket lens) for at least the first tour of his service, and perhaps for two years, and compelled to raise *normal* crops with no artificial aids of any sort" (D., p. 354).

"The essential remedy" for palms supposed to be dying from the attacks of *Bacillus coli,* he found to be "proper cultivation, growing . . . in the proper place on a proper soil in the proper way, with plenty of light and air" (D., p. 359).

And he was always ready to make fun of an excessive eagerness to rely upon "economic" methods. Thus, when he found, for the first time in Africa, gnats of the genus *Harpagomyia* being fed by *Cremastogaster* ants, he wrote :—

"Our sanitary authorities if they get wind of this, will have out an Ordinance decreeing the destruction of all *Cremastogaster* nests, ranking them with the neglected sardine tin as friends of the mosquito and foes of humanity. I once heard an authority on these matters declare that on any station of which he had charge, he would never allow anyone to grow a Pawpaw. Did we not know that it was the favourite food of the ♂ mosquito? Starve them then; make them die of inanition and the ♀s not being hermaphrodite and autogenous, would likewise sink into a decline. Alas for the eupeptic pawpaw! Of course, coming as I do from Scotland, I may have failed to notice that he was jesting. But he was (I regret to say) a Scot too, and if one Scot can't tell when another Scot is jesting, who can, I ask?"

Farquharson's years at Moor Plantation during the war were full of anxiety and discomfort. His brother was in the trenches in the Ypres salient and was wounded in October, 1917. One of his leaves home was saddened by the death of his father in 1916. Then, in his last two years there was much sickness in S. Nigeria, although Farquharson himself kept well, a result which he attributed to his out-of-doors study of natural history. Thus he wrote on August 14, 1918:—

"There is not much room for what one might call the higher life. A short evening for tennis and a long one for cards and drinking about sums up the average official's life outside the drab round of the office. Without a decent hobby I don't think I could have stuck this long tour, and it has been a very great pleasure to me to try to fill up some of the few lacunae in Lamborn's work, however imperfectly. I hope I may be able to do more, but I am grateful indeed for the chances I've had to do even a little."

And earlier, in November, 1917: "When I am finding things, really good ones, I must say I never think of the possibility of going sick. The worst that can happen to me here is to have time to worry."

Farquharson considered, contrary to the usual belief, that the "dry season in many respects is not superior to the wet, up-country at least," and that "it is in the dry season that men get run down, although the effects only come out in the wet."

But, however refreshing the rains may be, there appears to have been too much of a good thing in 1917, when he wrote: "I spent the whole of a wet September here. In my bush hut there was only one dry 'island' when it rained, and that was my camp-bed over which I had slung a ground-sheet. Nice little Hepaticas and graceful little ferns are growing on the mud walls. I think it must have been the fact that I couldn't help laughing at it all, that kept me well. It wasn't official solicitude for my welfare. There were no funds available to buy thatch which, strange as it may sound, is hard to get here. And then I got that wonderful Lycaenid find [p. 393] and one or two others."

Another discomfort was an indirect result of the war—the disorganisation of work in his Department, bringing uninteresting columns of accounts and the management of labour. "I haven't got near my own office the whole tour and am only mycologist in name," he wrote in September, 1917. And nearly a year later:—

"I have been having a most tiresome time doing up arrears of work (not my own) before going on leave. I wouldn't mind doing overtime or interesting work, but what I am doing any native clerk could do, a dreary totalling up of columns of labour expenses in the working of this plantation. I suppose I'll get to know how much it takes to hoe or weed acres of crops (without the aid of any labour-saving machinery and by methods impossible to apply commercially); but how I detest the work! However, the mail took my mind off the dreary business."

And here too, as he wrote on another occasion of the same uninteresting work: "If it weren't for the ants and the Lycaenids I'd be ill off indeed. Man cannot indeed live by bread alone."

The submarine campaign was at its worst on the West Coast, and Farquharson was always full of anxiety about his notes and precious parcels without which his observations would lose nearly all their value. He was continually hearing of disasters, and losses among his friends, and words written in December, 1917, were prophetic of his own fate on the "Burutu":—

"I hear that over twenty Nigerian passengers were drowned—off Holyhead, too, almost within sight of home! Another Hohenzollern laurel!"

As in his letter to Dr. A. W. Hill (D.), so, continually in his letters to me, Farquharson referred, with anxiety and evident foreboding, to the submarine menace. Of several passages from his letters already published (C., pp. 141, 142), I here reprint a single one because it is so clearly written in the spirit of a last message. It is very touching that he should speak as he does of work which gave me quite as much pleasure as it gave him.

"The submarine statistics naturally have most interest for those about to go home. I do hope I may get safely through and back, but if not it cannot be helped. Before I close, however, and in case this might be the last of me, I would like to thank you again for the great and kindly interest you have taken in the little bits of things I have been able to do, not to mention the patience with which you have tried to guide me. I've no doubt if I get no other chance to do better, somebody else will. [Aug. 14, 1918.]."

But he felt, after his long stretch of twenty-three months on the West Coast without a leave, that "three months at home is something worth taking a risk for," and he was longing "for a sight of Scotland."

The memories of survivors, recorded in letters and in "West Africa" for October 12 and 19, 1918, bring before us a vivid picture of a voyage in the Great War. The "Burutu" left Lagos on September 2, a day later than Farquharson had supposed, and reached Freetown, Sierra Leone, on the 7th. Here labour, reduced by influenza, required twelve days for taking in coal, water, etc., and the mails were transferred to the Escort-ship of another convoy. When they sailed on September 19 the "Burutu" was one of nine steamers, including three troopships. The voyage was uneventful until about October 1 when it became very cold and the sea rather heavy. At about this date destroyers met the convoy and took six steamers to southern ports, the remainder being escorted north by one destroyer and two "Mystery" ships.

At about 11.0 p.m. on October 3, cold and wet with a rough sea, the "Burutu," steaming without lights, within three hours of Holyhead, was run down in the darkness by a larger vessel, the "City of Calcutta." Then came a second collision with the same steamer, and this cut the boat clean in two and she sank in eight or nine minutes after the first blow—"lost just as fully through the Germans' unspeakable sea practices as if they had torpedoed her."

Some boats and gear were carried away, others capsized when lowered, and, although the "City of Calcutta" did what she could, it was only possible, in the heavy sea and intense darkness, to rescue a small proportion of the passengers and crew.

Captain W. E. Potter was on the bridge directing till the last moment when he told the passengers to save themselves, and went down with his ship. There was no rushing about or disorder of any kind although for part of the time after the first collision all lights were extinguished and friends could only recognise each other by their voices.

Mr. A. J. Goodwin, Executive Engineer of the Public Works Department, Southern Nigeria, Farquharson's cabin companion, remembers his high spirits on the voyage and his energy in the deck games, when, with a "brither Scot," he tried to knock spots off the Sassenach. He was the expert on the War, and, with his large maps, most helpful when the daily wireless arrived. With the other passengers he took his share of watches, an hour-and-a-half each, in the danger-zone, and his friend thinks that he was on duty that last evening up to 7.0 p.m. Mr. Goodwin found him just after the first collision getting his coat and life-belt on in the cabin. He was quite cool and collected, and being ready first, was on deck before his friend. Then came the second collision and they saw each other no more. Mr. Goodwin thinks that he may have been in an overturned boat from the keel of which six survivors were rescued after about nine hours. His body was found off the Welsh coast and buried at Aberdeen.

The words of his first great teacher in science are a fitting conclusion to this brief life of an exceptionally gifted and exceptionally well-trained naturalist.

Among the sons of the University of Aberdeen who "have toiled and died in many lands and seas in the service and defence of the British Empire, of freedom, and of the just cause . . . none was of higher promise or gave more faithful service than Charles Ogilvie Farquharson. . . . His personal friends will retain the memory of an earnest, unselfish, and fearless seeker after truth, of great ability, but most free from vanity, ready at all times to help others by deed as well as by word, whose death has brought to them a sense of grievous loss" (C., pp. 138, 140).

A. "Nature." Vol. cii, 1918–1919, pp. 192 and 371 (referring to D).

B. "Alma Mater: Aberdeen University Magazine." Vol. xxxvi, No. 1, December 4, 1918, p. 2. Written by two College friends.

C. "The Aberdeen University Review." Vol. vi, 2, No. 17, March, 1919, pp. 138–143. By Prof. J. W. H. Trail and Prof. E. B. Poulton. Contains a complete list on p. 143 of his Entomological publications in Proc. Ent. Soc., Lond., 1913–1918.

D. Royal Botanic Gardens, Kew, Bull. No. 10, 1918, pp. 353–361. Contains a long letter dated August 23, 1918, from C. O. Farquharson to Dr. A. W. Hill, F.R.S., Assistant Director.

E. Reprint of above in Supplement to "Aberdeen University Review," March, 1919, pp. 193–200.

F. Proceedings of the Entomological Society of London, 1918, pp. clxvii and clxxx.

INTRODUCTORY NOTE (E.B.P.).

It will be obvious to the reader that this memoir was never written or intended to be published as a scientific paper. The author wrote hurriedly and freely of the observations which had interested him and the material he was sending. He wrote in the intervals of a very hard-worked life in the Tropics. Had he lived, several formal papers would have appeared, each dealing with a separate subject. But, as this was not to be, it seemed best to analyse the whole correspondence and to group the contents according to the subjects treated of, combining with each an account of the illustrative specimens and a record of the brief accompanying notes. These accounts precede the groups of extracts from letters, and, being editorial, are enclosed within square brackets, as also are any substantial additions to the extracts themselves. Slight verbal changes, to the making of which the writer had freely consented in his lifetime, are not indicated, and it has not been thought necessary to add name or initials to the bracketed words. A single pair of brackets has been considered sufficient to indicate the authorship of two or a few consecutive paragraphs, but when several are included, initials have been added.

In the systematic and descriptive appendix, where the editorial additions are much shorter and fewer, it has been thought better to add the initials E.B.P. as well as the usual brackets.

The authorship of footnotes in both text and appendix is indicated by initials, except in purely formal editorial notes.

In the frequent references to the Proceedings and Transactions of the Entomological Society of London the abbreviated forms Proc. and Trans. Ent. Soc. have been employed, Lond. being usually omitted.

The great majority of the letters were written at Moor Plantation (p. 326), and this place is to be understood in the absence of any indication at the head of an extract. The only other locality which appears at all commonly is Agege (152 ft.), sixteen miles north of Lagos, where there is a Government farm often visited by Farquharson. The few remaining localities are described when first referred to in the extracts.

The material has been mounted and labelled with the greatest care by Mr. A. H. Hamm and Mr. J. Collins of the Hope Department, and by Mr. H. Britten, formerly of the Department, and I desire to express my thanks for their valuable help in this intricate work.

The specimens may be studied in the Hope Department; also, as regards some of the types, co-types or para-types of certain species, in the British Museum (Nat. Hist.) and in collections of the authors.

It is hoped that the detailed table of contents will be a sufficient guide, and, as regards subjects, an index, to a memoir which is, of necessity, varied and elaborate.

A glance at this table will show how very much has been contributed by the distinguished authorities who have worked out the author's material, and have thus done so much for his memory.

I also wish to express warm thanks to the following eminent specialists who have given the kindest help:—

G. J. Arrow, Maj. E. E. Austen, D.S.O., H. A. Baylis, D.Sc., Prof. M. Bezzi, K. G. Blair, Prof. G. H. Carpenter, B.A., D.Sc., W. C. Crawley, B.A., F. A. Dixey, M.A., M.D., F.R.S., H. St. J. K. Donisthorpe, F.Z.S., E. A. Elliott, F.Z.S., C. J. Gahan, M.A., D.Sc., J. J. Joicey, F.L.S., Dr. K. Jordan, Ph.D., C. G. Lamb, M.A., W. A. Lamborn, G. A. K. Marshall, C.M.G., D.Sc., The Rev. F. D. Morice, M.A., S. A. Neave, M.A., D.Sc., L. B. Prout, Capt. N. D.

Riley, The Rev. Canon K. St. Aubyn Rogers, M.A., Hugh Scott, M.A., Sc.D., Miss Lorrain Smith, T. A. Sprague, O. Stapf, Ph.D., F.R.S., G. Talbot, W. H. T. Tams, and Rowland E. Turner.

Although the present memoir cannot claim the precision and condensation of a formal scientific paper, it is given, by the author's letters, a character and charm of its own. We are often made to feel as though we were present with the writer and sharing all his enthusiasm and delight. For this reason a statement made in an earlier letter is retained in a later one if its omission would weaken the freedom and force of a description.

Furthermore, the author's letters bring home to us more intimately than would be possible in more formal writings the stimulating and encouraging knowledge that one who, at the start, was not an Entomologist, one whose days were filled and overfilled with other work, should have been able to do so much for Entomological science.

A. OBSERVATIONS ON LEPIDOPTERA, ESPECIALLY THE LIFE-HISTORIES OF LYCAENIDAE IN THEIR RELATIONS TO ANTS.

I. LIPTENINAE: INTRODUCTORY NOTE (E.B.P.).

Almost nothing was known of the life-history and earlier stages of the Lipteninae until the publication of W. A. Lamborn's paper in Trans. Ent. Soc., 1913, p. 436. Aurivillius, in "Rhopalocera Aethiopica," gives only two references—(1) to Roland Trimen's brief account and figures of the larva and pupa of *Durbania amakosa* Trim. ("South African Butterflies," vol. ii, 1887, p. 216; vol. i, 1887, pl. ii, figs. 2, 2*a*); (2) to his own paper in Ent. Tidskr. (vol. xvi, 1895, p. 207, pl. ii, figs. 1, 1*a*, 1*b*), describing Sjöstedt's discovery of a larva and two pupae of *Hewitsonia kirbyi* Dewitz on the whitish grey, rather mottled bark of a tree. They closely resembled the bark and were very difficult to find. The description of both stages and the figure of the pupa show great similarity to several of the Liptenines collected by Farquharson and described and figured by Dr. Eltringham in the present paper. The larvae of *D. amakosa* were gregarious and fed upon a common species of grass, *Anthistiria ciliata.* Numerous pupae were grouped close together, attached by a slight silken web to a rock. Nothing was known of the food-plant of *Hewitsonia*, but it is now certain that the larva had fed upon the filmy lichen encrusting the bark.

Lamborn's paper referred to on p. 337, with Dr. Eltringham's description and figures of *Euliphyra* (*ibid.*, p. 509, pl. xxviii), brought a great advance; for we are here given an account, on pp. 446–457, of the larval and pupal habits of three species—*Aslauga vininga* Hew., *A. lamborni* Beth.-Bak., and *Euliphyra mirifica* Holl., and the pupal habits of three species of *Epitola*, viz. *ceraunia* Hew., *carcina* Hew., and *oniensis* Beth.-Bak. Furthermore all six species are shown to be related to ants—for the first time in the Lipteninae. The larvae of the two first-named species fed upon ant-tended Coccidae, while *Euliphyra* was fed by the ant *Oecophylla.* It is unlikely, however, that such food is primitive in the Lipteninae any more than in the Lycaeninae; and we owe to Farquharson the important discovery, briefly announced in Proc. Ent. Soc. 1917, p. lxi, that bark-encrusting lichens on trees bearing the carton nests of *Cremastogaster* ants form the food of many Liptenine larvae—in fact, with the exception of the grass eaten by *Durbania*, the only larval vegetable food-plant at present known in the whole group. When we reflect that this, for a Lycaenid, extraordinary larval food is common to forms so different as *Teratoneura*, *Hewitsonia*, *Epitola*, *Iridopsis*, and *Citrinophila*, it becomes certain that it is wide-spread among Liptenines, and possibly their primitive food-plant.

In addition to this great increase in our knowledge, Farquharson shows that some of the imagines feed upon secretions of ant-tended Coccids and plant-glands, and even drive away the ants.

Dr. Eltringham's descriptions and beautiful figures (pp. 473–89, Pls. XII, XIII, fig. 3) include not only the fine material sent by Farquharson but much of Lamborn's as well; and, combined with his account of *Euliphyra* (*l.c.*), they give us a wide survey over the earlier stages of this most remarkable group of butterflies.

A. TERATONEURA ISABELLAE DUDGEON.

[Farquharson's first *Teratoneura* was a female taken at Moor Plantation, Dec. 12, 1913, in the act of drinking the secretion of ant-attended Coccids on a twig near the Apocynaceous *Cremastogaster* ant-tree *Alstonia congensis*, on which larvae and pupae of the Lycaenid were afterwards found. The following letter was written to his friend W. A. Lamborn, the others to me.]

Moor Plantation.

Dec. 24, 1913.—In response to your request I am now sending you a few notes on the Lycaenid which I brought in on the 12th of this month.

About six o'clock in the evening I happened to pass the tree on which you had some time previously shown me some ant-attended Coccids. I was rather surprised to see a butterfly evidently in the act of sharing with the ants in the fluid provided by the Coccids. At the time, the Lycaenid was hanging from the underside of the twig with the wings outspread. Being unprovided with a net, I had to adopt the only other method possible, to catch it. Fortunately, owing to its intentness in supplying the wants of Nature, or to its natural " protectedness "—for even in the falling light it was by no means inconspicuous, I secured it easily with my fingers, and was pleased indeed that you regarded it as quite a prize.

Feb. 18, 1914.—I received the letter with the great news of *Teratoneura*, last mail, which pleased me very much indeed, but I hasten to explain that its ever having reached the Hope Department is due in the first instance to Dr. Lamborn. From the note which I made at the time of finding it, you will readily perceive that it interested me primarily from its being found in the act of sucking up a Coccid secretion. This was a new thing to me, though, of course, not to my friend. He told me so, but went on to congratulate me with considerable solemnity, so that I felt rather awed and inwardly congratulated myself that the creature had been so intent on its meal that I, without a net, and absolutely innocent of its possible identity, yet managed to catch it by the precarious method of the finger and thumb.

I wonder if any of us will ever penetrate the secret of the larval *Teratoneura*.

1. *The Life-history of Teratoneura.*

[The bred series of *Teratoneura*, illustrating the following sections, includes 8 males and 9 females from larvae on the bark of, or pupae on or near, the "ant-tree" *Alstonia*, already mentioned. The first, a male, A, which emerged about Dec. 9, 1916, at Agege, where Farquharson happened to be at the time, and the second, a female, B, emerging Feb. 15, 1917, are accompanied by their pupa-cases of which one, the male, is represented on Pl. XII, fig. 9; see also p. 477. The remaining 15, emerging Feb. 24–March 8, 1917, are also indicated by letters for their respective pupae, but these were never received, although two parasitised pupae were sent (p. 459) together with two spirit specimens of the extraordinary larva described and figured by Dr. H. Eltringham (p. 476, Pl. XII, figs. 7, 8, 14, 15).

The pupal period of one female was 10 days—pupation Feb. 14, emergence Febr. 24.

The following notes on 8 specimens indicate that emergence usually takes place about noon or within the 2 or 3 hours after it: ♀ before noon; ♂ about noon; ♀ a little after noon; ♀ about 1.0 p.m.; ♂ after 1.0 p.m., probably about 2.0; ♀ 2.30 p.m.; ♂ after 2.0 p.m.; ♀ p.m.]

Feb. 22, 1917.—I send you two butterflies with their pupa-cases. One I got just before going to Agege in December. I had to take it with me and it emerged there. I have seen no more of them till lately, when I have secured about a dozen pupae which I now have. Very likely Lamborn has sent them before, but they are new to me. I send one authentic larva which I put into spirit yesterday. When alive it is very Lymantrid-like, with bright colours and spots. The pupa is a "decayed"-looking thing, like a mouldy object of some kind, till it is closely examined, when it is wonderfully fine. When the first butterfly emerged I thought a Skipper had got in by mistake. The resting position is very Skipper-like. I have now seen quite a number of larvae of which I will write to you more fully later. This is simply a hurried foreword. They have legs like *Hewitsonia* larvae and run about among the ants in the same way—*Cremastogaster* as before.

May 18, 1917.—I got the great news that it *was Teratoneura* that I'd got hold of after all. I am sending you the rest this mail and hope to send their pupa-cases and one or two parasitic Chalcids next mail. I'll be so vexed if submarines get this lot. I'm really nearly afraid to send at all, but the wet season is setting in and things are apt to spoil if kept. I will answer all the points you raise in detail next mail, which will be in about a week, I think, for I cannot get time just now. It was indeed very odd that I should find the *Teratoneura* first and re-discover it even to its larva. I may say that the larvae that I had feeding were all definitely of the species, no question whatever.

I am especially pleased about the *Teratoneura*, because I really knew what I was after and managed to do it. Of course it would never have happened but for Lamborn, and it is so very kind of you to take so much trouble over it all.

2. *The Larva of Teratoneura.*

[The Lymantrid appearance of the larva was very evident in the spirit specimens and is shown in Dr. Eltringham's figure (Pl. XII, fig. 8; and the description, p. 477; see also p. 342). It is also the fact that *Teratoneura* is the only butterfly larva yet known which has the urticating type of spicules, although their effect has not been observed. Mr. W. A. Lamborn happened to be at home when the larvae arrived; he recognised them directly, but said that he had always mistaken them for moth larvae.

On Dec. 25, 1917, Farquharson bred the Lymantrid moth *Naroma signifera* Walk. from a larva on the Apocynaceous tree *Alstonia congensis*, on which *Hewitsonia*, *Teratoneura*, and other Liptenine larvae were found. The specimen was referred to on Jan. 26, 1918, in the following passage, in which "*Hewitsonia*" was probably written for "*Teratoneura*," although the former also appears on the notes accompanying the specimen: "The moth with the *Hewitsonia*-like larva is rather interesting. The larva is very like a *Hewitsonia* larva and lives on ant-trees (I have only, however, found two, and of these one was accidentally destroyed). It has two glands, in the mid-dorsal line on segments 9 and 10, protected by spines. Hardly any cocoon is spun—simply a few threads—and the cast skin is left hanging near the pupa." Further specially directed observations will be required in order to test the conclusion that these larvae always feed on ant-trees and are the models of *Hewitsonia*, *Teratoneura*, or other Liptenine larvae. *Naroma signifera* is an extremely abundant and wide-spreads pecies, bred in large numbers by Lamborn at Oni and by Carpenter in Uganda, and ranging to Natal. The two mid-dorsal glands are characteristic of Lymantridae.]

March 1, 1917.—The larvae are very remarkable, being very hairy, and, on the naked parts between the tufts and bands of hairs, brightly pigmented with red, green, yellow, and perhaps other colours—such colours as one associates with Lymantrid caterpillars. The larva is more moth-larva-like even than *Hewitsonia*, though of the same general character, even to the little "sucker" that is found on the outside upper edge of the pro-legs [pp. 352, 355, 383, 485], which is retracted when the foot is lifted and exserted when it touches the bark of the tree or whatever the larva is walking upon.

3. *Teratoneura Larvae and Ants.*

March 1, 1917.—The fact recorded in the last paragraph [of the section on Pupation, p. 346] led me to look for evidence of attacks by the larvae on Coccids, but with entirely negative results. Except when about to pupate they are never found on leaves nor among the Coccids. Up and down the stems of the two big trees a busy column of ants in loose formation about 5 to 8 deep is constantly running. They do not appear to stop night or day, for I have gone down after dark to see if the larvae could possibly be night-feeders. I have seen several larvae on the way to pupate wandering down the column in a leisurely way; ants coming in the opposite direction turn aside, those coming behind keep a respectful distance. There is no hostility shown, nor yet friendly attentions such as mark their behaviour to possessors of Guenée glands. It is really extremely difficult to get the larva to leave the ant-column. I have pushed them away, but they persistently return. A tiny twig intruded among the ants is immediately attacked.

4. *The Larval Food of Teratoneura.*

March 1, 1917.—I haven't seen any of them feeding so far, as I have seen *Hewitsonia* larvae, at least apparently feeding. I think they feed high up the tree, but I have examined the frass microscopically and am to send you a specimen or two by this mail [not received]. It is a mixture of vegetable débris of a very odd kind, little bits of tissue, I think cortical, largely sclerenchymatous in one or two smears I have made—I got a fine bunch of store-cells in one, fungus spores mainly referable to phaeosporous Hyphomycetes, hardly two spores being alike, just such a collection as one could scrape off a bit of "clean," living bark (that is not decayed); very little fungus mycelium—so far as I have yet seen—except fragments of brown-coloured hyphae; numerous Algal elements, not filaments but sporing or resting stages. I am on the whole inclined to believe that they are lichen-feeders, but I intend to go into the question more fully, for *Hewitsonia* larvae are now beginning to appear. I am also to compare frasses of different larvae of known food-plants. If they were bark-feeders there would be a larger proportion of undigested cortical matter. Algal filaments would probably be more numerous instead of only sporing stages. I am inclined to think that the fungus constituent—at least hyaline mycelium—is digested. Resting brown mycelium might escape. At the moment I am ashamed to confess that I do not remember whether any group of lichens has a brown mycelium.* Brown spores are common enough, but I have an idea that the thallus is always hyaline. I will look up De Bary to-morrow. I remember at the time I found the *E. honorius* larvae [pp. 351–53] that some of their frass left in a jar, the walls of which were moist, formed centres for the growth, a vigorous growth, of filamentous Algae. Perhaps you may be able to induce some Algologist to try the experiment with the frass which I send you. If I lived in a forest district I'm sure I could quickly settle the point, but I feel rather confident of clearing up a good bit of the problem here.

Yesterday I liberated two (immature) of the hairy Lycaenid larvae [*Teratoneura*] after starving them for 24 hours. I put them in the ant-track on the bark of the tree. They appeared to start feeding at once, and the ants simply walked round them. I then cut off a piece of the bark and enclosed the larvae in a perfectly clean tin. This morning I found fresh frass. The food material is about the most unpromising stuff I've ever seen.

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* Miss A. Lorrain Smith has kindly written on this subject:— "Some few lichens have brown mycelium, but that is rather rare. What is almost universal is the brown under cortex and rhizinae of larger forms and the dark brown hypothallus of crustaceous species—the latter not so frequent.

"Bark lichens are a very favourite nidus for parasitic fungi. I often find very flourishing brown mycelium—stout hyphae—pervading the lichen fruits. There are crowds of minute fungi parasitic on lichens.

"The brown mycelium might thus be very easily explained as part of the larval food and may be either fungoid or lichenoid in origin."—E.B.P.

March 18, 1917.—I have a nice series of the Lycaenid with the Lymantrid-like larva. There is no question about their not being carnivorous, nor leaf-eaters, nor flower-eaters, but cortex-feeders. I have not yet cleared up what part of the cortex it is of which they are specially fond. I am inclined to the lichen theory still, for I now know of two trees of distinct Orders on which the same larvae occur, one a *Ficus* (Moraceae, Tribe Ficeae), the other an Apocynaceous tree which I believe is *Alstonia congensis* (author's name [Engler] I do not know at present, but I will find out). Now these two Orders are widely separated, but have one thing in common—latex. But the larvae live on old bark and it cannot be the common factor, latex, that they are after, for they would have to do what a Bostrichid beetle could hardly do, and, as a matter of fact, it takes a good deep cut on old cortex to draw latex. The marks of their mandibles even when one sees them feeding are not visible to the eye, and what they take off must be a very thin layer indeed. The lichens on these trees are of the extremely thin crustaceous variety—so thin that they simply look like different coloured portions of normal cortex, and that makes observation all the more difficult.

5. *The Larval Food of Liptenine Allies of Teratoneura —Epitola, Hewitsonia, Iridopsis, Citrinophila, Eresina.*

Feb. 26, 1916.—I am practically satisfied that the whole group with hairy larvae, *E. honorius*, *Hewitsonia*, *Iridopsis* [including almost certainly *Citrinophila* and *Eresina*], feed on Algae or lichen on the bark of the trees on which they occur. I've examined frass of *Hewitsonia* and *honorius* too. However, I will I'm sure be able to confirm it next tour. The *honorius* larvae, as you received them, were shrivelled a bit, but in life they were exactly similar to Hewitsonias, so much so that I thought their brown colour as distinct from the mottled greyish-green of the *Hewitsonia* larva was a cryptic variation, as they were on a tree with brown bark.

March 18, 1917.—I am certain that *Hewitsonia* is of the same type as *Teratoneura*. Curiously enough I have seen a *Hewitsonia* settling on the aerial rootlets of the *Ficus* on several successive nights lately. The *Epitola honorius* larvae are also, I am sure, of the same kind, and indeed their shape is exactly that of the *Hewitsonia* larvae, though their colour is brown, a snuff-coloured brown with plenty of hairs, giving them a moth-larva-look. The *Hewitsonia* and *Epitola* larvae are also alike in being rather broader anteriorly—with a square-shouldered sort of shape, as it were—than posteriorly. This is not quite so marked as in the *Teratoneura* larvae, but, now that I know a little about them, I would have no hesitation in associating them with Lycaenidae, and with each other among the Lycaenidae, if I saw them on ant-infested bark, the ants being *Cremastogaster.* The little Lycaenid [*Epitola concepcion* Suff.] that I sent, with the hairy larva and *Hewitsonia*-like pupa, is, I am certain, of the same order, as also is *Iridopsis.* I found at least three other larvae among ants of the same type last tour in travelling through a forest district, but couldn't do anything with them, as they were too young. I do wish I could get a month's holiday in a forest district, and I'm nearly sure I could work out as many of this type as Lamborn did of the others. It is rank bad luck being here for such work. I am very curious to know the systematic position with regard to each other of those I have just mentioned. Are they really closely related or is it a case of convergence? [They are certainly nearly related.] I have an idea in my own mind that this group of Lycaenids in a sense correspond to certain xerophytes of the plant world. A desert plant if put into competition with ordinary trophophytes and left to make the best of it is choked out by its better adapted rivals and perishes in the midst of plenty. In the desert it thrives in apparently starvation conditions, but the little there is is enough for the few that can stand the conditions. We can hardly imagine even Germany making war on the Eskimos, to use another analogy. It may be so with this group. What with poor fare and the ants, probably few insects would care to invade their field. One could imagine Satyrines being left to starve through an invasion of Army worm or Locusts.

Dec. 29, 1917.—The hairy, "eremobiotic" types, that live in a desert of ants, neither tolerated nor attacked but simply ignored, giving nothing and taking nothing of any consequence to the ants, though securing indirect protection, the Hewitsonias, Teratoneuras, etc., have of course quite visible heads. I use the word "eremobiotic" to express this insect counterpart of the desert "xerophytic" plant. Synoekete implies a more intimate relation, more applicable, is it not, to guests (welcome or not) living *inside* the nests? Perhaps eremosymbiont, if that is a legitimate coinage, fairly nearly expresses the idea. Wasmann, according to Wheeler, uses the term trophobiosis to describe the more common relation of the Lycaenine Lycaenids. In a "trophic" classification of Lycaenidae the two terms contrast fairly naturally. They cannot be ranked with the scafferying * neutral synoeketes, and I'm sure to most insects the "playing field," of a *Cremastogaster* colony especially, is a veritable desert. In case such a term were too particular, implying absolute proof rather than the more or less hypothetical, atrophic and syntrophic symbiosis is perhaps a better general description.

6. *The Pupation of Teratoneura.*

March 1, 1917.—The larva pupates either on a leaf or on a slender dead twig or dead herbaceous stem on the tree or round its base. The trees on which they are found throw out numerous very slender aerial roots, which hang down from the stem and branches. These are favourite pupation places. When these end in the air and not, as they sometimes do, become re-attached to the parent tree lower down, ants do not generally run down them. Such a place would be relatively safe at the critical, vulnerable period of transition. *Argiolaus* pupae are generally to be found on shrubs or herbs at a little distance from the ant-tree, and when, as happens at times, they pupate on a plant too near the tree, the pupae are frequently devoured by the ants which respected them or even protected them as larvae. But the *Teratoneura* almost as frequently as not pupates on a leaf with the base of its stalk within an inch of Coccids and ants.

7. *Teratoneura Pupae heavily parasitised by Chalcids.*

Feb. 22, 1917.—I notice that the pupae are heavily parasitised by Chalcids, and I cannot say I have ever seen a parasitised *Hewitsonia* of a good many seen by me now.

March 1, 1917.—I think I remarked on the frequency with which this species is parasitised, a very tiny Chalcid and a much larger one being the culprits. [For the species and numbers see p. 459.] I have seen many *Hewitsonia* pupae, old ones on trees besides those I've bred out and let away, and do not remember having got one parasitised. I have been in the way of breeding them out as I found them and letting them away without keeping records, but I intend to look into the question of their parasitism more particularly now. *Hewitsonia* larvae are protected by the ants (unconsciously, for they give no return) and also by their cryptic coloration both as larvae and pupae. The larva of this other species [*Teratoneura*] is brightly coloured. It asks for trouble, but no doubt is partly protected by the ants, as is *Hewitsonia.* As a pupa it has succeeded very well in looking like nothing in particular—a valuable disguise I should think, but it is at this stage that it is attacked. I saw a tiny Chalcid on one, one day.

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* "Scaffery" is defined in Murray's Oxford Dictionary as—"Extortion, extortionate taking of perquisites."

8. *Other Enemies of Teratoneura.*

Feb. 28, 1917.—Just underneath that passage in Shelford [p. 350] the subject of birds eating butterflies is mentioned. I may say that under these trees I have seen one or two butterfly (the Lycaenid) wings that may have been the remains of a bird meal.

March 1, 1917.—By the way, I saw a large green Mantis with the remains of a larva one day, but it had left the ants and gone on to a leaf to pupate. Of that I feel sure, for, as it happens, the small stump with its suckers is haunted by one or two Mantises, but they do not go on to the stems among the ants. It may be, however, that the imago wings I saw on the ground were the work of a Mantis.

9. *Teratoneura Imagines feeding on Secretions of Ant-attended Coccidae and driving off the Ants.*

Feb. 28, 1917.—I have had further opportunities of studying the butterfly of which I sent you two specimens last mail, the one with the hairy Lymantrid-like larva. I find that the species appears to haunt the tree on which the larvae are found. By the way, it is just beside the place where I found the *Teratoneura* in Lamborn's time (see p. 339). I am wondering whether I can possibly have hit on that form again, for this species appears to specialise (in the adult stage) in Coccid secretions as food. On this point I have one or two observations to send you which may be of interest. One or two points are rather extraordinary, but I have taken great care in the matter and I do think my interpretation of what I saw is fairly reasonable. Let me first explain the conditions. Two trees of the same species (which probably belongs to the Apocynaceae) had grown up together, but, in partially clearing the land, one was cut down to within a foot or two of its base, and the other was left. From the stump of the one cut down a large number of sucker shoots have sprung, the tips of which are just about 6 feet from the ground. The ends of the lateral branches are nearly all being sucked by Coccids, all of which are ant-attended. Both the big tree and the stump are wholly over-run by ants, though their main habitat is in the big tree and in another of the same species about 6 feet away. They do not have a carton nest, but appear to live in holes in dead branches, though this I have yet to verify. There is a constant stream of ants up and down the trunks of both the big tree and the stump too. About a week ago, on Thursday evening, Feb. 22nd, to be exact, I was trying to find out what the larvae might feed on, suspecting the Coccids as their prey, for pupae are very commonly found near them—often indeed on a leaf of the twig they are sucking. Suddenly I noticed one of the butterflies alight on a twig, as I thought, perhaps to oviposit. It remained for a few seconds and then flew off, circling rapidly round the stump, soon to alight again. It lit on a branch with ants and Coccids on it, and I felt sure I was to see what I've not so far been lucky enough to witness—a Lycaenid ovipositing. I suppose my anxiety to see this prevented me "tumbling" to what really was doing. The butterfly lit just at the tip of the branch, the Coccids being about an inch behind that. It proceeded to walk backwards rather slowly and deliberately, the abdomen inclined upwards at a fairly steep angle to the thorax, and the wings opening and closing fairly rapidly—though not by any means nervously or excitedly—and gently beating the twig. The ants retreated backwards, making hardly any resistance at all, though some dodged to the underside of the twig and ran forwards. The butterfly having gone back about three inches then suddenly dropped the abdomen so that it rested on the twig and ran rapidly forward, the tip of the abdomen brushing the twig as it did so. The backward manœuvre was repeated, this time on the underside of the twig, the wings then hanging downwards, the abdomen flexed as before. I was still waiting for the egg-laying marvel. I thought I was to see it to some purpose, when "she," if that really was the sex, let the abdomen rest on the twig. But Lamborn used to swear that females that really wanted to oviposit and knew that one wanted to know the food-plant, really did that to annoy the onlooker: so I kept on hoping, till "she" suddenly stopped over the Coccids, unrolled a very slender proboscis and proceeded to absorb the secretion so much prized by the ants. Occasionally an ant would venture along, but retreated without attacking. In a short time the butterfly flew away, circled round for a bit and came back to another twig, where the same performance was repeated. By this time I had formed the conclusion that she was deliberately hustling the ants off what they doubtless regard as their own particular prey. What exactly is the "force majeure" to which the ants yield I do not know; the flapping of the wings isn't a very formidable thing, but it seemed to act and the ants did keep their distance. [The movements described and the position of the abdomen suggest strongly that the butterfly produces and fans towards the ants some odour disliked by them.] I tried the effect of interfering with their lawful preserve by "tickling" the Coccids with a thin grass stalk. Soldiers and workers immediately seized it and held it fast enough to let it be suspended in their jaws when I let go. They had all the appearance of being most justly indignant. I saw the butterfly repeat the performance three times. The performers were only about one foot from my eyes and were not the least bit shy. I failed to catch the leading performer. It was one with the light, predominantly red, underwing. Now I know that nearly every twig of the big trees has Coccids and ants on it, for I got a ladder and looked at some of the lower branches. This evening, about 6.15 p.m., from the ground I counted on the nearest branch of one of the big trees eight butterflies, all busy on the ends of twigs.* Yesterday evening I saw several, and with the aid of the ladder satisfied myself that they weren't merely hung up for the night. I wondered if they were night- or dusk-feeders, and have gone down twice at noon to have a look. The Harmattan is on here just now, and it is extremely hot and dry. In such weather *Monomorium* becomes a dreadful nuisance in its search for moisture, and at mid-day most open-country insects are fairly quiet and seek the shade, but this particular Lycaenid appears to be very active just then. They are very rapid fliers and may be seen, some chasing each other round the branches or in the open near the trees, while others occupy tell-tale positions on the twigs. I wonder if this habit of "tapping" Coccids is confined to open-country forms in districts of rigorous dry seasons and scarcity of water. But now I am on dangerous ground. Peradventure I may be numbered in that "vast majority of collectors and field-naturalists [who] are poor philosophers," * or in that other equally melancholy crowd of "zoologists [who] are sorry failures when it comes to observing the living animal in its natural surroundings." † But I do lay the flattering unction to my soul that I am not a "collector."

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* *Dec.* 24, 1917.—*Teratoneura* nearly always settles on branches well above the ground, and these branches are always scale-infested. I have never seen them alight on low herbaceous plants, or on the ground—and I'm sure I could see a dozen any day I like—rather luxurious entomology, is it not?—C.O.F.

10. *Other Lipteninae—Epitolina, Mimacraea—with Habits similar to those of Teratoneura as described in the last Section.* [A few weeks after the observations recorded on pp. 347–350, Farquharson observed and sent the much smaller Liptenine *Epitolina dispar* Kirby, "as a specimen of a Lycaenid with the same (adult) habits as *Teratoneura*." The butterfly bore the following note: "March 15, 1917. Small Lycaenid observed driving away ants from plant-gland, to suck secretion. Habit similar to hairy larva Lycaenid [*Teratoneura*], only probing plant-gland" instead of Coccid secretion.

On Dec. 14, 1917, three *Epitolina dispar* were captured, together with one male *Mimacraea fulvaria* Auriv. "Drinking plant-gland secretion on Coccid-and-ant-infested plant" is the note borne by one *dispar*, and a shortened form of the same by the others. The *Mimacraea* has in addition, "Captured at Ibadan in act of drinking secretion." On hearing that this latter was a Lycaenid Farquharson wrote, April 28, 1918: "I was astonished at the Acraeine Lycaenid mimic. I would give something to breed it out. I saw several of them at the same place, and it never entered my head that they were Lycaenids at all. I would never doubt mimicry after that."]

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* "A Naturalist in Borneo," R. Shelford, London, 1916, p. 207.

† *Ibid.*, p. 208.

B. NOTES ON THE LIFE-HISTORY AND LARVAL AND PUPAL AFFINITIES OF HEWITSONIA, EPITOLA, ERESINA, IRIDOPSIS AND CITRINOPHILA.

[In the following section a number of interesting notes from Farquharson's letters are arranged in order of dates. The material on which the conclusions were built may be inferred from the following list of specimens now in the Hope Department, remembering that Farquharson observed far more than he collected, sometimes, as he tells us, breeding out these butterflies and letting them go. *Iridopsis* and *Citrinophila*, considered in the two succeeding sections, also form part of the material on which the following notes were built. It must be remembered that in the earlier notes "*Hewitsonia*," as used by Farquharson, includes three species of *Epitola—hewitsoni, miranda* and *honorius*.

Hewitsonia similis Auriv.—Two males bred at Agege, Oct. 9 and Oct 11, 1917. Both larvae and pupae were found in this locality on the bark of *Antiaris africana* Engler—at Moor Plantation on that of *Alstonia*. The pupa-cases were not sent.

Epitola hewitsoni Mab. (Farquharson's "*Hewitsonia*, New Series A.")—One female, somewhat deformed, bred at Agege, Oct. 19, 1917. The pupa was found, Oct. 16, attached to a leaf, probably near the ant-tree *Antiaris*. The pupa-case was not sent.

Epitola miranda Staud. (Farquharson's "*Hewitsonia* B. type.")—Two females both bred Jan. 27, 1918. Both larvae and pupae of this species were found on the bark of *Alstonia*. The pupa-cases were not sent. Lamborn also obtained four examples from the same locality in 1913, and, curiously enough, all are females. The larva of one was found Oct. 26, pupation took place Oct. 28 and emergence Nov. 6. The other three were captured July 10, Oct. 31 (on stem, feeding on Coccid secretion), and Nov. 6 (10.0 a.m. on blade of dead grass). The only male of this species in the Hope Department is from the S.W. of the Victoria Nyanza (Proc. Ent. Soc., 1918, p. xciii). In the British Museum there are 2 ♂ 3 ♀ (3 ex Coll. Staud., 1 ♀ W. Vict. Nyanza, 1 ♀ W. foot Mt. Elgon); at Tring—6 ♂ 1 ♀ (all Sierra Leone); at Witley—2 ♂ (1 Sierra Leone, 1 without locality).

Epitola honorius F.—One female, deformed, bearing the note: "*Hewitsonia* sp. with brown larva, found at Shagamu.

Pupn. about 8.ix.15 while travelling; emerged 19.ix.15." The pupa-case, attached to a piece of bark, was sent (Pl. XII, fig. 16, p. 475) together with 3 larvae in spirit (Pl. XII, fig. 17, p. 475). The larvae were found on an ant-tree and others believed to be the same on a similar ant-tree at Agege.

Epitola concepcion Suff.—One female with the following note: "Larva found resting prior to pupation, 10.i.17. Pupn. completed next day; emerged 19.ii.17." The larva was found on the bark of *Alstonia*. The pupa-case was sent, but one of Lamborn's is shown on Pl. XII, fig. 13.

Eresina corynetes Gr.-Sm.—One female found on the bark of *Alstonia*, Jan. 17, 1918. Referred to in a letter of Jan. 26, 1918:—"The small Lycaenid—captured—from the *Hewitsonia* tree. I took it because it was slightly malformed. I have an idea that it had not long emerged, but couldn't find a pupa-case."—E.B.P.]

July 26, 1915.—The mail as I said came on Sunday, and I had one from Lamborn too. I always go out into the bush on Sunday if it doesn't rain, and that day was no exception. I always visit the Lycaenid trees here. Lamborn told me to look out for a *Hewitsonia* larva, and I have in spirit here what I believe to be one.

Sept. 28, 1915.—I now know the larvae of *Hewitsonia*, but haven't yet solved their food problem. But in my three weeks' trek I saw them on every ant-tree I met. The larvae run about among the ants, which do not touch them. I will send specimens next mail if I get a chance.

I also got larvae of identical form [*Epitola honorius*] but of dark brown colour on an (*Cremastogaster*) ant-tree, but of seven only one pupated and the imago is deformed. I found the larvae in forest at a town called Shagamu, which is about two or three days' trek (about 50 miles) from Epe (N.W.): I've not seen them here.

The pupa of the one here at Ibadan [*Hewitsonia similis*], if pupation takes place on a green plant, is coloured more dominantly green than those that go up on bark. I'll write them up more fully, however, later. At present I haven't the time. On the larval feet (pro-legs) are what appear to be glands. I have seen them crawling over a glass lid. They may be found on other larvae of Lepidoptera. They do not appear to secrete. They are on the outer side of the foot, rather like this. [Sketch in letter. See pp. 342, 355, 383, 485.] I think the part is retractile. I think they are lichen-feeders, but I intend to examine the frass. They won't feed in captivity.

The *Hewitsonia* larvae, by the way, are in no sense ant-attended. They keep in the track of the ants and rest in crevices in the bark quite near the nest. The ants do not heed them. I think they are protected by their hairs and bristles. The ants unwittingly protect them from other foes.

Nov. 24, 1915.—I was so astonished at the Shagamu, one being an *Epitola* [*honorius*]. The larva in form is exactly the same as that of the *Hewitsonia*; only the brown colour is different. They look more like moth larvae. I send you one or two which are unfortunately not normal in size and aspect. I found seven at Shagamu which looked as if they might be about ready for pupation, so I put them in tins with fixed bits of bark for transport as I had to keep travelling, but only one pupated. The rest tried and failed, so that they are little more than skins. I am to send next mail one or two good *Hewitsonia* larvae [not received] and you will be better able to judge their characters; so far as I can make out Lamborn never saw the *Epitola* [*honorius*] larvae.

The *Hewitsonia* larvae are never attacked on the tree, but in a small tube where free movement was prevented, one of several enclosed ants got in between the hairs and proceeded to bite the larva to its great distress. I think they are night-feeders, for in the daytime they are quite passive.

I am so curious to hear what the relationships of the Hewitsonias and Epitolas are. The Shagamu *Epitola*, with its brown larva, in its larval stage is as like to a *Hewitsonia* larva in characters, down to the foot "gland," as any two larvae with different colours can be. They are not like any other larvae I know. As a further point I may mention that several *Hewitsonia* larvae exactly the same in colour as these here, occurred on the same tree with the *Epitola* brown ones at Shagamu. I got some of the ants, but they moulded extremely badly and got destroyed, but the ant is almost certainly the same as the one on the tree here—a small *Cremastogaster*. On a tree at another place on the same trek I saw a *Hewitsonia* larva on a tree associated with a *Cremastogaster* of about the same size, but with a reddish-brown abdomen. [The ant is probably *Crem. buchneri* Forel, r. *clariventris* Forel, found associated with the larvae of *Lycaenesthes* sp. *? alberta* Beth.-Baker by W. A. Lamborn. Trans. Ent. Soc., 1913, p. 476.]

Feb. 26, 1916.—*Hewitsonia* larvae are not to be found now. However, we've had the first tornado of the year and the rains are about to resume.

Government Farm, Agege.

Dec. 15, 1916.—I am almost positive that, on a tree nearby that bears a large *Cremastogaster* carton nest, a few larvae (young ones) crawling thereon are those of the *Epitola* I found in Shagamu last tour [*honorius*], which mimics, I think, *Planema epaea*. I'll try to farm out the rubber business till one or two mature. They are mixed with *Hewitsonia* ones and possibly an *Iridopsis*. I will send you some frass for microscopic examination as soon as I can. But what a pity that I get so little time in high forest districts, for it's there that the carton nests abound, and I'm positive that I could do a lot to clear up a number of very interesting life-histories. I will do what I can here, but the whole place has been cleared to make cocoa farms, and nests are few and far between.

Moor Plantation.

Feb. 22, 1917.—I have been long in following up my last letter for two reasons, first because I did not have any luck at all with the *Epitola honorius* at Agege. . . . I got one larva to pupate and lost it, the ant *Monomorium* being responsible. I had watched daily several larvae that were coming on nicely, but they always disappeared and I failed absolutely to find the pupae. I'm not sure that they succeeded in pupating. I saw several new broods, but either they went too high up the tree or they were destroyed by some enemy.

I did find one enemy which I am sending by to-day's mail. I saw it actually attack a medium-sized larva and kill it. To do so—it is a Reduviid bug [*Sphedanolestes* sp., with the note "Agege, Dec. 17, 1916. Reduviid preying on Lycaenid larva"]—it had to dodge about among the ants, but it managed that all right. I hope to get back to Agege in the wet season and may remain there a month, when I hope to do something.

I think the tree on which the larvae are found is the same kind as the one (in the Gambari district, about

24 miles south of this) on which I got the curious little Diptera last tour [p. 444]. You may recall my description of their curious larvae, which wandered about freely among the ants. I did not find them, however, at Agege. I do not know the species of tree, but it is habitually inhabited by ants, and always carries large carton nests.

[The following note in the same letter refers to *Epitola concepcion* Suff.] I have also sent you another little Lycaenid with a very *Hewitsonia*-like pupa-case. I bred it out from a larva (a hairy moth-like larva too) which I found about to pupate on Lamborn's old *Hewitsonia* tree [*Alstonia*].

March 18, 1917.—I must say the *Epitola honorius* pupa-case more closely resembled the *Hewitsonia* than either of them resembles the *Teratoneura* and yet the poise of both is not unlike, though the two former have a much broader attachment than the latter. In fact, I think that except for the colour of the pupa (and in *Hewitsonia* at least it varies a little to harmonise with the background) which is rather darker in *Epitola,* I should find it hard to tell one from the other.

All the larvae have the little protrusible process on the outer side of the pro-legs (one spirit specimen of *Teratoneura* shows these exserted), but so also have the *Pterocarpus* larvae [Lycaeninae, see pp. 383, 485, &c.].

Agege.

Oct. 18, 1917.—I have also sent two *Argiolaus* and two *Hewitsonia* from a tree here in Agege on which I got the very tiny Lycaenid of which I told you last mail, which duly emerged. I am waiting for a large mail steamer to carry *it* home. The tree is a tall buttressed one of the Apocynaceae family, I think [it is the Moraceous *Antiaris africana*], but all round the base I found fallen *Loranthus* corollas of a different species from the one on which I got the Lycaenids at Ibadan. There is, of course, a *Cremastogaster* nest rather beyond my reach. I took in the *Hewitsonia* pupae for a special reason. I was to put you a query about them and found you had put it to me in slightly different form. Of that I will say more. I, as a matter of fact, was to suggest that the *Hewitsonia* larva was rather variable, and was to promise to look into the question closely.

Moor Plantation.

Dec. 24, 1917.—I went down again in the afternoon (Sunday) of these great events [Dec. 23. See Proc. Ent. Soc., 1918, p. xxxii–xxxv]. It is worth something in the conditions in which I have to work at present, to know that at almost any spare moment in daytime I can go down feeling tolerably certain that if I choose I can see such things as *Teratoneura* larvae, just for the trouble of going to the particular tree, or *Hewitsonia*, or—a great many other things. As I was looking out for opportunities for catching the myrmecophilous Diptera on the stem of the *Funtumia*, a *Hewitsonia* actually came along (it was then about 3.30 p.m.) and laid two tiny ova in the track of the ants. It was done with such rapidity that I had difficulty in locating the tiny ova, and the ants didn't seem to suspect their presence either, or, if they did, took no notice. The ova were pale yellow in colour. It is extremely unusual to see *Hewitsonia* on the wing. I have often wondered if they are night-fliers, though it may be that they fly around tree-tops.

Jan. 26, 1918.—By the way in the proof of the Lycaenid notes you refer to "the genus to which *Epitola honorius* belongs."* From the larvae I would have sworn they were Hewitsonias, adapted in colour to the brown bark of the tree on which I found them. They were as alike and more so than the *Loranthus*-eating larvae of *Argiolaus*.

Feb. 8, 1918.—Mail day. The box I have sent is not so interesting nor so complete as I'd have liked. I have mislaid the pupa-case of the *Hewitsonia* [*Epitola hewitsoni*], which is characteristic in not lying along the bark of the tree with its long axis parallel to the tree surface, but sticks out at about 70° in a very odd position. I will be able to write more fully on the point later.

Feb. 14, 1918.—The big crumpled one that went by the same mail is one of the "*Hewitsonia*" series. When I said there were three species [*Hewitsonia similis, Epitola hewitsoni* and *E. miranda*] I was thinking more of the similarity of larvae, which is quite as close as that between the various *Argiolaus* larvae in shape. Only in the case of *E. hewitsoni* the pupa-case projects outwards at an angle from the substratum on which the pupa rests. The B series of "*Hewitsonia*" [*Epitola miranda*] which is on the way home also has a projecting pupa, but the third one's [*Hewitsonia similis*] pupa lies along the surface of the substratum. But their larvae and that of *E. honorius* are extremely similar in form, only differing in colour. I am trying to get a carefully differentiated series to clear up the whole thing. I have only seen about 3 species of *Charaxes* larvae. They are all of the same shape and not like any others I know. *Argiolaus* larvae are nearly as alike in some ways, but the *Hewitsonia* or *Epitola* larvae are as unmistakably related by form and habit as *Charaxes* larvae. I thought for a time that the changes in colour were cryptic changes of one form. *Teratoneura* is a little different. *Iridopsis* is nearer, but the larva has the distinctive habit of spinning a silk protection before pupating. You will notice too the likeness of the *Citrinophila* pupa-case to the *Hewitsonia* and *Iridopsis* types. If only I had time and a forest district to work in I could do them all up. When the Director comes back I think I'll try to get a local holiday to a forest district. I know exactly where to look for these things, and I've only to get into a decent district to get lots more of other species. I think I'll have earned a holiday, for I've been nearly 17 months out now without anything but the statutory days—Xmas, Bank, Empire, New Year, and it isn't much. At times I don't feel any too willing to get up early in the morning, and I lose more sleep than I like to. Still one must make the best of things. This is an extra mail, sprung on us on two days' notice, so I won't have time to write more.

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* In the British Museum this species was assigned to a distinct, undescribed genus.

C. THE LIFE-HISTORY OF IRIDOPSIS INCREDIBILIS STAUD.

[The following notes refer to a male and female *I. incredibilis*, which emerged on Sept. 30 and Nov. 6, 1915, respectively, the pupae having been found on the bark of *Alstonia* a few days earlier. Both pupa-cases were received.]

Nov. 24, 1915.—I also got off two little Lycaenids which I do hope will reach you all right, as I have a feeling that even two (if they arrive in good order) will be, at least in a small way, a Xmas contribution that will interest you. I know the larva, but have not yet got one in spirit. It also comes from the *Hewitsonia, Argiolaus maesa*, and *A. alcibiades* tree [*Alstonia congensis*] that Dr. Lamborn loved here on Moor Plantation. I feel sure they also are relations of *Hewitsonia.* Their larvae are of the same general hairy character and like the others run about in the vicinity of the ant-nest, over the bark of the tree. I am not yet certain what they feed on. I think it must be Algae or dead bark. They have no dorsal glands, and are disregarded by the ants though they run about in their tracks. I think it is an association of mutual respect. The Lycaenid larvae are protected passively, so to speak, by the ants. No other insects that would be likely to harm them will venture near them for fear of the ants. It is not a beneficial partnership (nor yet the reverse), for, as I say, the ants simply ignore them, seeming unable to attack them on the tree.

Feb. 26, 1916.—The *Iridopsis* larva which I once saw was on the *Hewitsonia*-tree here [at Moor Plantation]. I've wondered uneasily several times whether I hadn't misplaced the imago among the Lycaenids, for the brown chitinous-looking pupa-case, distinct and separable from the cast skin which completely envelopes it, is very moth-like. Further the larva spins a fairly dense web of white silk to form a little cage in which I found the pupa in each case. It selects a fairly deep narrow crack or pit in the bark of the tree for the purpose, in a manner recalling the habit of some spiders. I feel sure I'll be able to get more on my return next tour—if the Huns do not get us going or coming by sea. The larva has a denser protection of hairs than the Hewitsonias, but shorter, and they are not quite so active. In shape they rather differ, and as to the process on the pro-legs which I saw in *Hewitsonia* and the *honorius*, I'm not sure in this case.

Agege.

Dec. 15, 1916.—On the way down here [Agege] I stayed two days at Olokemeji, the Forestry headquarters. On an *Albizzia lebbek* Benth., with quite a number of *Iridopsis* empty pupa-cases on it, there was a *Crematogaster* nest similar to the one seen at Agege (p. 354).

[The following paragraph refers to a male *Iridopsis incredibilis* found about Dec. 7, 1916, on the bark of the Leguminous tree mentioned above.]

Moor Plantation.

Feb. 22, 1917.—The name of the tree—"Lebbek"—is a corruption, I think, of an Egyptian name. It is not native here, but is used as a shade tree. I got a butterfly on it just emerged, which may be an *Iridopsis*.

[The butterfly referred to below is a female *I. incredibilis*, with the pupa-case in its silk-covered depression in the bark. They bear the date of emergence, Jan. 14, and the notes "Larva hairy and predominantly red" and "pupa in shallow depression in bark—silk-covered." There is little doubt that the tree was *Alstonia*.]

Jan. 12, 1918.—I have a Liptenine pupa just now which I found as a pupating larva not long ago—the pupa not unlike a *Teratoneura*, but the larva was different and "went up" in a depression on the bark of the tree after weaving a silk defence like an *Iridopsis*. The silk was finished before I met the larva and I couldn't disturb it, but the predominant colour was red, and I do not think I have seen it before. [*Jan.* 26.—"It is a fine big *Iridopsis*." —C.O.F.]

Feb. 8, 1918.—I send the *Iridopsis* and its pupa-case—it is the one I told you of that had the larva with a lot of red. *Iridopsis* has one curious character: it generally pupates in a niche in the bark of the tree, but first spins a web of silk so as to shut itself in as some spiders do.

Aug. 25, 1918.—[After referring to various Diptera and to larvae of Endomychid beetles, etc., haunting the "ant-tree" (*Alstonia*) at Moor Plantation the letter continues.] There were also one or two young *Hewitsonia* larvae, and I saw an *Iridopsis* come and oviposit. This must sound rather a tall yarn, all these things on one day, but such are the facts.

D. NOTES ON THE PUPATION AND LIFE-HISTORY OF CITRINOPHILA TENERA KIRBY.

[The single specimen sent by Farquharson is a male. It is accompanied by its pupa-case still attached to the bark of the Pará Rubber tree, *Hevea brasiliensis* Müll. Arg. (Euphorbiaceae). It bears the note "Lycaenid found newly emerged on Pará tree, Agege. Pupa-case found also. 18.x.17."]

Agege.

Oct. 18, 1917.—This forenoon as I was examining tapped surfaces of Pará trees in connection with a really difficult disease problem that I think I may manage to solve, without the aid of a fungus (or, of course, an insect), I saw a newly emerged Lycaenid, a bright yellow one with black-tipped wings. And just beside it was its empty pupa-case! Nowhere round it was a plant of any sort except rubber, the shade being too dense for weeds, and I feel sure he is of the bark-feeders. I won't send it this mail, for surely such a load would be too much for the old boat. Nor is this an end to the wonders that Lamborn enabled me to see—how I wish he were here! [*Oct.* 20.—" The pupa-case is remarkably spiny."—C.O.F.]

Moor Plantation.

Feb. 6, 1918.—There is a shady little place by the river where every day, if I care, I can see a half-dozen of the little yellow and black forms. They are always fluttering round a huge tree with a promising-looking bark, but few ants except *Pheidole*. I feel certain every time I see them that their life-history is about six feet away, but I've had no luck so far. Lycaenids in my limited experience are never far from their breeding-place, but the trouble is to find it. Some of them, of course, may oviposit on the tops of high trees.

II. LYCAENINAE.

A. Notes on the Life-histories of nine Species of Iolaus (Tanuetheira, Argiolaus and Epamera) with Larvae feeding on the Flowers of Loranthus incanus Schum. and Thonn.

[Farquharson's interesting notes are illustrated by the following fine series of bred specimens, with many of the pupa-cases from which they emerged, and some of their larvae sent in spirit. The larvae and many of the pupae, reconstructed from their cases, have been described and figured by Dr. Eltringham in the Appendix (pp. 473–89). The pupa-cases sent by W. A. Lamborn were substituted for Farquharson's in two of the species, and in addition to the West Coast pupae, that of an East African *Argiolaus*, collected by Lamborn and the Rev. K. St. Aubyn Rogers, is described and figured (Pl. XIII, fig. 1; pp. 480–81). Dr. Eltringham also comments on the Guenée gland, the " electric " sensation produced by these larvae, etc. (pp. 484–85). For a brief preliminary statement of the facts recorded in this section see Proc. Ent. Soc., 1917, p. lxi; 1918, p. lxxix; for Farquharson's observations on ants attendant on larvae of *Myrina*, Proc., 1914, pp. xxiii, xxiv.

1. *Tanuetheira timon* F. (Farquharson's A).—2 ♂ 2 ♀, emerging between Dec. 14, 1917, and Feb. 10, 1918; accompanied by 3 pupa-cases, one noted as that of the first butterfly to emerge, a ♂. The dull green larvae on flowers of *Loranthus incanus* parasitic on sparsely *Pheidole*-haunted *Funtumia elastica* Stapf (Apocynaceae). A larva sent in spirit is figured by Dr. Eltringham together with one of the pupae (Pl. XIII, figs. 5, 7, 11; pp. 478–79).

2. *Argiolaus alcibiades* Kirby (Farquharson's G and "Gall affinis").—5 ♂ 2 ♀, emerging from about August, 1915, to Jan. 24, 1918: 3 ♂ 1 ♀ are accompanied by their precise pupa-cases. Larvae on flowers of *L. incanus*, on *Cremastogaster*-haunted *Alstonia congensis* Engl. (Apocynaceae), never on the same *Loranthus* on *Funtumia*. Most of the specimens bred from pupae found on shrubs beneath the *Alstonia*. One ♀ was bred Oct. 4, 1917, at Moor Plantation, from a larva found at Agege on the flowers of an allied species of *Loranthus*, on the *Cremastogaster*-haunted *Antiaris africana* Engl. (Moraceae). The pupa of a female (Jan. 23, 1918) is figured by Dr. Eltringham (Pl. XIII, fig. 2; p. 480). Lamborn also bred this species from a pupa attached to the leaf of a climber on a tree bearing a huge nest of *Cremastogaster buchneri* (Trans. Ent. Soc., 1913, p. 474).

3. *Argiolaus paneperata* H. H. Druce (Farquharson's B).—7 ♂ 12 ♀, emerging between March 4, 1917, and Feb. 4, 1918: 2 ♂ 4 ♀ accompanied by precise pupa-cases: one ♀ emerged about 8.0 a.m.: one ♀ emerging Jan. 8, 1918, pupated Dec. 29, 1917. In addition to these 19 specimens, a dwarfed ♂, emerging Feb. 9, 1918, and sent as D (*Epamera iasis*), probably belongs to this species. The blue colour resembles that of the ♀ rather than the ♂ *paneperata*, a possible result of unfavourable conditions. It is certainly not *E. iasis*. All the larvae on flowers of *L. incanus* on *Funtumia elastica*, at Moor Plantation, but 2 ♂ emerged at Agege (Oct. 22 and 23, 1917). This, the commonest larva, feeds when the flowers are immature, and exactly resembles their "dull green—a sort of bud-scale green shot with brownish hairs." The larva is figured (Pl. XIII, figs. 9, 18; pp. 479–80).

4. *Argiolaus iulus* Hew. (Farquharson's F).—2 ♂, emerging Feb. 25, 1917, and Jan. 23, 1918. Each is accompanied by its pupa-case (Farquharson's "decorated pupa"). Both larvae were from *L. incanus* on *Alstonia*, although Farquharson specially notes on the label of the 1918 ♂ that he had bred it before from the same *Loranthus* on *Funtumia*. The 1917 pupa is figured (Pl. XIII, fig. 4; p. 480). This species was also bred by Lamborn from larvae on a parasitic climbing plant. He notes that they had a dorsal gland and were attended by a race of *Cremastogaster buchneri* (Trans. Ent. Soc., 1913, pp. 474–5).

5. *Argiolaus maesa* Hew. (Farquharson's H and "Gall").—4 ♂ 1 ♀, emerging Aug. 14–24, 1915: all with precise pupa-cases. Larvae on flowers of *L. incanus* on *Alstonia*, never on the same *Loranthus* on *Funtumia*. The larva is also found on an allied *Loranthus* on *Antiaris* at Agege. The figured pupa is an ichneumoned one which has kept its shape better than an empty case. It was collected by Lamborn at Moor Plantation (Pl. XIII, fig. 17; p. 481).

6. *Epamera laon* Hew. (Farquharson's E).—1 ♂: pupation Jan. 16, emergence Jan. 31, 1918. Mole-coloured larva on flowers of *L. incanus* on *Funtumia*. A ♂ pupa collected by Lamborn at Oni, 70 miles E. of Lagos, is figured (Pl. XIII, fig. 15; p. 481). The characteristic position of this pupa, across the stem, was noted on the specimen by Lamborn, Feb. 18, 1912.

7. *Epamera iasis* Hew. (Farquharson's D).—5 ♂ 7 ♀, emerging Jan. 11–Feb. 11, 1918. The ♀ of Jan. 11 is accompanied by its pupa-case, which, although somewhat flattened by the packing, still shows its position across the stem of *Loranthus*, near to a "cushion" (p. 368) which it resembles. All the larvae were on flowers of *L. incanus* on *Funtumia*. This larva replaces the commonest, *A. paneperata*, and becomes itself the most abundant when the flowers mature and open. They are pink or red when young and may become yellow or yellow-orange later on, thus matching the changing colour of the flower.

The last consignment of *E. iasis* included a dwarfed ♂ probably of *A. paneperata* (p. 361) and 2 ♂ of *E. mirabilis* (p. 363).

8. *Epamera farquharsoni* B.-B. (Farquharson's C).—2 ♂ 7 ♀, emerging Jan. 9–14, 1918, the first 6 being ♀. The first ♂ and seventh ♀, of Jan. 13, emerged about 2 p.m. The pupa-cases are of much interest. The ♀ of

Jan. 9 is accompanied by 2 cases to which the same number (C 1) had been accidentally fixed. Each is attached to a stem of *L. incanus* and lies across it in the usual *Epamera* position. A female of Jan. 11 (the ♀ type) and of Jan. 13 are accompanied by their respective cases fixed to the bark of the *Funtumia*. They are extremely well concealed and probably possess the power of individual colour adjustment. The pupa-case of the ♂ (type), Jan. 14, is also fixed to the bark, but close to a prominent ridge which probably supplied the same stimulus as a thin stem; for the pupa lies across it at an angle of 45°. Finally, a pupa-case, found empty on a *Loranthus* stem, lies across it just above a "cushion." This is the specimen figured by Dr. Eltringham (Pl. XIII, fig. 10; p. 482). For the larvae see Pl. XIII, figs. 6, 12; p. 482. As implied above the larvae were always found on flowers of *L. incanus* on *Funtumia*. They are the caterpillars with the extraordinary resemblance to the flowering cushions which surprised and delighted Farquharson.

Farquharson devised an excellent method for sending these pupae in their natural surroundings. A thick piece of bark with the pupa in the centre was cut out, probably with a chisel, and pressed into a thick bed of glue at the bottom of a stout cardboard box. When it arrived, I cut through the glue round the edges of the bark, with a fine-toothed saw, leaving that beneath as a flat base on which the specimen rests in the drawer. The bark and glue were carefully drilled in two places for pins to prevent shifting. Thus all moisture was avoided and the bark with its Cryptogamic growths remains quite unchanged.

For Mr. G. T. Bethune-Baker's description of this species see pp. 462–63.

9. *Epamera mirabilis* H. H. Druce (labelled D by Farquharson).—2 ♂, emerging Feb. 12, 1918, both from the *Funtumia* mistletoe. The specimens were compared with the unique type from Sierra Leone (now in the possession of Mr. J. J. Joicey), and Mr. H. H. Druce agreed that there was no doubt about their specific identity. The ♀ unfortunately still remains unknown; Mr. Druce's conclusion that *mirabilis* is allied to *iasis* is supported by Farquharson's employment of the same letter D for both forms, showing that he did not distinguish them in the earlier stages.

Mr. Druce has informed me that the figure of *mirabilis* in Trans. Ent. Soc. Lond., 1907, Pl. II, fig. 8, represents only a single hind-wing tail—the central one—although the type possesses all three. In the text (p. 81) and also in the original description (Ann. Mag. N.H. (Ser. 7), vol. xi, 1903, p. 71) there is an inadvertent error in the statement that the insect lacks the row of hairs on the inner margin of the hind-wing under surface. The fore-wing is, of course, intended. The absence of the patch of special scales on the shining area of the hind-wing upper surface where it is overlapped by the fore-wing, and of the hairs on the fore-wing under surface by which, in other species of the genus, these scales are covered, is emphasised by the name *mirabilis*, and leads the author to remark that the species "seems to open up the question very forcibly as to whether distinctive genera can be made on the absence or presence of these 'sexual marks.' It appears to agree in venation exactly with *Epamera*."—E.B.P.]

[In the following extracts from Farquharson's letters the species referred to are indicated in square brackets.]

July 26, 1915.—I got to Lycaenid tree No. 1 [*Alstonia congensis* Engl.] from which the Hewitsonias are obtained, and was looking intently at the bark from different angles. I got nothing on the tree at that time and passed on to the next one. Here Lamborn found that extraordinary gall-like pupa [*Argiolaus maesa* Hew.]. I had the great luck to get a larva which has since pupated. I also found on a small shrub at the base of the tree a pupa of another species [*Argiolaus alcibiades* Kirby]. I can hardly hope that it is one Lamborn didn't get. It was on a leaf. Its shape, with the broad tail attachment, in general resembled the other, but it is not really gall-like. Unfortunately at the head end which appeared to rest on the leaf, there appeared to have been a slight exudation of the living matter. The pupa was a dull olive-green colour. I took it in, however, in hopes that it might not be irretrievably damaged. Yesterday a wretched Ichneumon emerged. But just in case Lamborn didn't get it, I went back yesterday and on another little group of shrubs, hardly more than seedlings, I actually got two healthy-looking pupae, of an apple or Alga green—not shining but dull green like the surface of a tomentose leaf. There had been a third one which had got damaged and was being eaten by little

Cremastogasters off the ant-tree. But the two are safe, and if an Ichneumon comes out I'll be very angry indeed. I went back yesterday evening, and, as the place is rather shady and it was getting dusk, I failed to notice that the ground was simply alive with black drivers before I had quite half a dozen biting like fury under my nether garments and a lot more running up the outside. It was lucky I got the pupae in the morning or they'd have been eaten up that night. There's nothing succeeds like success, and I went there this evening and got another "gall" larva. I was actually expecting to find the larva of the other, and I may do so before long.

July 29, 1915.—The pupa of *A. alcibiades*, though not striking, is in a general way, in its "pose," rather like the gall one [*A. maesa*].

Sept. 28, 1915.—The *alcibiades* larvae do not feed on beans. They come down the ant-tree—Dr. Lamborn's "*Hewitsonia*-tree," a species of *Alstonia* [*congensis*], haunted by *Cremastogaster* ants—just as *maesa* does. They have, I think, a Guenée gland. I've got one in spirit. They have no tubercles.

Feb. 22, 1917.—I think I have two new *Argiolaus* pupae [*A. iulus* of which a ♂, emerging Feb. 25, 1917, was received]. One has just emerged, but it is too soft to kill as yet. I think the *Argiolaus* lives on a *Loranthus* parasitic on the same tree as the Hewitsonias, but I think its food may be a scale on the *Loranthus*. [This paragraph may have been written a few days later than the beginning of the letter.]

Feb. 27, 1917.—Before reaching it [the *Pterocarpus*, p. 382] I had to pass a tree where *Hewitsonia* pupae are at times to be found, and soon found three. For a special reason I examined one or two small shrubs of the undergrowth for other Lycaenid pupae, the special reason being the presence on the large *Hewitsonia*-tree (I do not know the species [*Alstonia congensis*], but believe it to belong to the family Apocynaceae), of two or three large *Loranthus* parasites, which I now believe to be the special habitat of the two species of *Argiolaus* [*A. alcibiades* and *maesa*] which I sent last tour and of the other sent last mail [*A. iulus*]. The larvae (not invariably but frequently) leave the ant-infested *Loranthus* to pupate, often travelling a long distance—60 ft. at least in some cases—to pass the critical, because vulnerable, stage between the larval and the completed pupal condition. I found two empty pupa-cases of the *Argiolaus* type and passed on to my *Pterocarpus* which was growing near by. Just under it I noticed another empty Lycaenid pupa-case, again of the *Argiolaus* type, which may indeed have come from the *Hewitsonia*-tree.

May 18, 1917.—Did I mention that I believed that the *Argiolaus* were probably somehow connected with a parasitic *Loranthus*? I am now in a position to say that they feed on the *Loranthus* flowers. I will tell you all about it next mail.

Agege.

Oct. 18, 1917.—Just before leaving Ibadan I noticed my *Loranthus* coming into flower. I think it flowers twice a year at least. I thought I'd look for some apparently fully fed larvae, for there's one form I failed to breed. Both the pupae I got were unaccountably spoilt. I found incidentally a large proportion of the flowers galled by a Psyllid, I think. Last time of flowering the flowers were normal. I got two Lycaenid pupae and several larvae [of *A. paneperata*]. That was on Friday the 12th inst. As bad luck would have it, I had no excuse left by which to avoid dining out and couldn't get near them on Saturday evening. The day was a busy one and any work on them then impossible. On Sunday I was rather out of sorts (a suspicious circumstance, but really unconnected with the unfortunate dinner) and in addition had to do some wretched packing up, as also on Monday. All this sounds most neglectful and I grieve to have to admit it, for last night I discovered what I had missed. The larvae had all pupated except one, which was manifestly dead. But in the bottom of the box (a glass-lidded tin of the ordinary kind) were several curious white threads, a ghastly, horrid Nematode I take them to be. There were I think five, two nearly as many inches long. If there is any class of animal on this earth that I loathe, hate and detest it is the Nematode. Snakes are, compared with them, a theme for poets. Perhaps after all it is a case of *ignotum pro horrifico*. Anyhow, they're in a tube with spirit and you'll get them in due course. There was absolutely nothing else in the box from which such huge things could have come unless they lived in the *Loranthus* flowers. Looking at their semi-opaque bodies with a lens, they have almost an annulate appearance and I will not guarantee their classification. They are unpigmented and *look* like Nematodes. That is enough for me! If I've libelled them it is their own fault. Men have told me that our common large Mantis frequently harbours a very long round worm, but I've never seen one. What I marvel at is their rate of growth, if these worms really did come from the Lycaenid larva. It must have been very rapid.

Port Harcourt.

Nov. 15, 1917.—My friend Dr. Connal, Director of the Medical Research Institute at Yaba near Lagos, examined the Nematodes that I believe to have come from the Lycaenid larva. He thinks they are Filariidae, but all the specimens were females and he would not venture on a nearer diagnosis.

[I submitted the Nematodes to Dr. H. A. Baylis of the Natural History Museum, who could not say more than that they were immature Mermithidae. Dr. Baylis' remarks may induce naturalists to help on the study of this parasitic group:—

"I have looked at the Nematodes from the Lycaenid larva, and am sorry to say that, as I feared, their characters are purely larval, though they are of such a large size. I am afraid, therefore, it is quite impossible for me to attempt to name them. The species to which the Mermithids found in Lepidoptera are most commonly referred (at least in Europe) is *Mermis albicans* v. Sieb., but I suspect that this is a conglomeration of species, which in their larval state it is impossible to separate at present. People should try to keep these worms alive for a time after their emergence from the insects, in order to give them time to mature.... I should be very glad if you would let me have any such living larvae of *Mermis* that you happen to come across. *Feb.* 24, 1920."]

Moor Plantation.

Dec. 24, 1917.—Now for this evening's adventures. I started (perforce) rather late and had very little daylight left, too little for the flies and mosquitoes, but of course I know that if I choose—and I probably shall—I'll get some more to-morrow. But I had noticed a day or so before that my *Loranthus* was exhibiting flower-buds, and I thought it was about time I had seen to it. Now these flowers are, when mature, long, tubular, yellow (a sort of *Potentilla tormentilla* yellow, but with a "matt" surface) things with red tips, the red being exactly that of a good old-fashioned Bryant and May match. The flower, in fact, has a by no means fanciful resemblance to a "Swan" vesta with a yellow stick. When mature the most abundant Lycaenid on them is one with a pink larva just delicately tinged with yellow and extremely difficult to see unless one knows how to detect them. [It is evident from a later letter, p. 372, that the larva is *E. iasis*; but the commonest species was ultimately found to be *A. paneperata.*] I am to send you a new series of these when they come on, for the *Loranthus* series threatens to be more complex than the *Pterocarpus* one [p. 381]. That tree, too, may soon be coming into flower. This evening's adventure has seriously complicated the *Loranthus* series. The *Loranthus* flowers are verticillate. They arise apparently, season after season, on the same "cushions," to use a term applied to cocoa-flowering. These cushions are rough and warty, brown in colour, tinged here and there with dull green. Arising on them and sticking upwards are found the flowers; at the present stage these are dull green—a sort of bud-scale green shot with brownish hairs. There is no trace of the red tip yet. I was not surprised to find the larva of the form from which I bred the Nematodes [*A. paneperata*]. It is exactly that colour. I expect to get a few and to be able to send one in spirit. I had taken my knife to cut off a "cushion" with its partially developed flowers when my eye caught sight of something that ought to have been a part of the cushion but was—another larva, a perfectly amazing cryptic form with curious knobs and an astonishing and quite indescribable medley of colours, a masterpiece of camouflage! [The larva of *E. farquharsoni.*] I got him safely into my tin and proceeded to cut off the cushion of flowers for it to "chop." Camouflage can have its disadvantages. Alas, I cut another one in two and my joy at finding No. 1 was seriously damped. But before it was too dark I got four in all. I'll get more, I'm sure, and I'll have one to spare for spirit. I'm positive, however, that I didn't overlook these before, when the flowers were in full bloom and the predominant colours were yellow and red. And the pink larva form [*E. iasis*] hasn't arrived yet. The colours [of *E. farquharsoni*] aren't bright nor are they many, but the few there are, green, brown and tiny hints of red, very very slight, are wonderfully blended. The *Argiolaus maesa* has a very odd larva and is slightly reminiscent of this one, but it is much less "knobby." Altogether to-night I think I have three different *Loranthus* forms and the pink one [*E. iasis*] is not included. All are wonderfully cryptic in their own way. What an astonishing piece of good fortune that a *Loranthus* should have grown on a *Funtumia* branch about ten feet from the ground. I just mount a step-ladder and pick them off in comfort. Curiously enough there are few ants on the trees and one of the forms has glands and tubercles (not *the* one, the camouflage expert). None were actually attended.

Dec. 27, 1917.—An odd thing struck me this evening. I have got, I think, four different larvae on the *Funtumia-Loranthus*. The tree with its parasite is not 30 yards from the *Cremastogaster-Hewitsonia-Argiolaus maesa*-tree, and yet I have never found *A. maesa* on the *Funtumia*, nor the other very large (the largest of all) *Argiolaus alcibiades* that is also found on the ant-tree. Yet I am sure they both feed on the same species of *Loranthus* that is also parasitic on the ant-tree. But it is not a *Funtumia*, though I think it is also Apocynaceous. [It was the Apocynaceous *Alstonia congensis* Engler.] It is much taller, three times as tall, and it may be that the species that oviposit there fly high. Yet it is odd that *maesa* and *alcibiades* are not found on the *Funtumia-Loranthus*, and it suddenly came into my mind this evening that the *Loranthus*-"aura," as it were, may vary according to its host, so that the chemotropic stimulus that impels a butterfly to oviposit in the one case is absent in the other. Of course it may be due to the absence of the Cremastogasters. The *Funtumia-Loranthus* is sparsely ant-tenanted, but a few *Pheidole* sp. being present, it would appear that the Lycaenid species do select particular ants. I have never found the *Funtumia* series pupae anywhere near the *other* tree. The *maesa* larva when it descends for pupation is always accompanied by ants, which it has difficulty in getting rid of in order to pupate in safety.

Dec. 29, 1917.—Two of the new Lycaenids [*E. farquharsoni*] have "gone up." The pupa is as cryptically coloured as the larva. The two pupae are somewhat oddly placed on the twigs of *Loranthus* in lying *across* the twig instead of what is more frequent, along the twig. I am sure this is not accidental. You will see why when I send you material. The pupa in this position resembles a flowering cushion. Undoubtedly the imago, whatever it is, must be first cousin to Lamborn's delightful "gall" [*A. maesa*]. It is very similar in "poise" and shape. The form with the most markedly "electric" [pp. 376–77] larva (which is a beautiful "Blue" with long tails [*Tanuetheira timon*]) has also pupated. I have put the other in spirit. I bred out an imago before from a pupa. I have lots of pupae of a third and apparently common form [*A. paneperata*]. I think I sent it before along with one which I noted as having an exactly similarly shaped pupa, but more "decorated" [*A. iulus*]. For some reason I haven't got any of the latter just now. The pink forms [*E. iasis*] are beginning to appear now that the flowers are beginning to show more colour though still unopened.

I cannot help thinking that the *Loranthus* series really *are* avoided by ants. I am not saying this simply because I wish to find a meaning for the "electric" sensation [see p. 376]. I noted it before I knew of that. There are *Pheidole* on the tree, but they are in attendance on scales and are partly, I think, attracted by the nectaries of the *Funtumia* flowers. Further, I took a lot of the same *Pheidole* from *Cassia alata*, where they are in attendance on a Jassid, and put them into the *Argiolaus* box, but they took no notice of the larvae. Two of the species *have* tubercles. I cannot find them on the species à camouflage [*E. farquharsoni*]. But I cannot find glands on any of them.

Jan. 8, 1918.—None of the new *Argiolaus* have emerged as yet, but I've a nice group of them and next mail may bring you some good things.

Jan. 12, 1918.—I am glad to say that I am in a position to make *one* emendation, and that is that there are more than *two Argiolaus* on the *Loranthus*. I know of FIVE on the particular *Loranthus* on my most particular *Funtumia*, and in addition it is practically certain that the famous "gall" [*maesa*] and the other which I sent home as "gall affinis" [*alcibiades*]—I haven't the names handy at present, but you sent me them before—almost certainly feed on the same species, though, as I told you in my last letter, the "gall" and the other one elect to live up a very tall tree, much beyond my reach—the *Alstonia* frequented by *Cremastogaster*, *Hewitsonia* and the others. The "gall" and one of my *Funtumia-Loranthus* forms live on the *Hewitsonia-Endomychid-Cremastogaster*-tree at Agege, which bears a very closely related *Loranthus* with purple red-tipped corollas instead of yellow and red-tipped, which by the way—the host-tree, I mean—is *Antiaris toxicaria*, var. *africana*.* I had just posted my letter on Tuesday when I found on my *Funtumia-Loranthus* still another extraordinary looking larva, very similar to the "camouflage expert" in shape, but in colour nearly black, a sort of dark "mole" colour except for one or two tiny white and brown spots posteriorly. I have searched for others without success and sadly believe that I must have missed them, for the one I had looked like a little bit of dead leaf that had accidentally stuck on a flower. I rather think it is the larva of the "decorated" pupa *Argiolaus* [*A. iulus*] to which I referred in my last letter. [It was the larva of *E. laon*.] I have one of these pupae by me and will soon be able to clear up the point.

Three of my "camouflageurs" [larvae of *E. farquharsoni*] came by an untimely end in a very curious way. A moth (? Pyralid) larva is present in considerable numbers on the flowers. I must have overlooked the presence of one or two of these in one of my tins in which the *Argiolaus* larvae were feeding. They in due course "went up," and I didn't trouble to put in more flowers. The wretched moth larvae attacked three pupae and devoured the contents, to my intense annoyance. If they had eaten the common species I wouldn't have cared so much. Still, I've got four perfect imagines and there are some more to come, for I got three that had pupated on the lichen-covered bark of the *Funtumia*, so wonderfully cryptically coloured, just like little burrs on the tree-stem. I tried to photograph them, but my plates have got heat-fog and I cannot get good definition.

I wonder if I mentioned that I have got another *Loranthus* (same species) on a *Funtumia* close by *the Cremastogaster*-tree and infested with outposts from the main ant-nest. It is in flower like the *Argiolaus* one, but not a single specimen can I find on it. I must draw a plan of the ground showing distances. I introduced Cremastogasters in numbers into a tin containing about a dozen *Argiolaus* larvae, but they made no attempt to attend them. The *Argiolaus-Loranthus* off which I could have got dozens of larvae is but sparsely ant-infested, *Pheidole* sp. being the ant, and they are in attendance only on various *Coccidae* on the *Loranthus*. I can, I think, definitely say that these larvae are *not* ant-attended in that particular instance at any rate. They have tubercles, seldom extruded, but I really cannot make up my mind about the gland. I have never seen any evidence of secretion, but I have thought I detected the " lips " of a gland. It may be rudimentary. I'll put up a few of the commonest species in spirit for sectioning. In the common, onisciform, ant-attended Lycaenids that I have met, there is no chance of missing the gland. The drop of secretion is always to be seen. The *Argiolaus* larvae also " spit," when handled, a drop of liquid which is at first clear but quickly turns green. It is probably acrid, but I haven't summoned up courage to try.

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* Dr. Stapf informs me that the name *toxicaria* has never been published, and the species is *A. africana* Engl.

Jan. 26, 1918.—I have posted for this mail two small boxes, chiefly devoted to the *Loranthus* series of Lycaenids. Six different species are sent, with a larva of four of the species.

The A series [*T. timon*] is not very common. I have only three imagines, one of which only I have sent this mail (so that I may have another try in case the submarines get them). It is a beautiful form as you will see.

B [*A. paneperata*] is perhaps the commonest one, *is*, in fact, till the *Loranthus* flowers are mature and open, when the D [*E. iasis*] series is predominant and common. The B larvae are green—a sort of mistletoe-leaf green. The D series have yellow or red larvae, and may be red when young and later yellow to match the predominant colour of the flower.

The C series [*E. farquharsoni*] is the type with the wonderfully cryptic larva. I cannot describe the colours, but imagine a blend of greens with tiny points of brown or red, such as you can find, say, on a tuft of *Peltigera* or *Cladonia* lichen. I have sent only one pupa-case, not in a typical situation. I'll send you these later, for I'll have to glue them to a small box to be effective.

F [*A. iulus*] came from the *Cremastogaster*-tree (not the *Funtumia-Loranthus*, though the parasite is the same in both cases)—*Alstonia*, the same species as the *Teratoneura*-tree, but a different specimen. But I once bred it before from the *Funtumia-Loranthus*. The larva is very like the B [*paneperata*] type.

The G series is my " gall affinis " [*A. alcibiades*], and is from the *Alstonia-Loranthus*. I haven't sent a " gall " [*A. maesa*], though I had a fine one that got damaged. I have a lot to send yet, but am to distribute them over a few mails.

E, the other wonderful *Loranthus* larva [of *E. laon*]—the dark mole-coloured one—pupated and will, I think, emerge to-morrow. The pupa is extremely like that of C [*E. farquharsoni*].

Feb. 8, 1918.—Lycaenid (*Loranthus*) E [*E. laon*] is the one with the mole-coloured larva. The pupa is extremely like that of the C [*E. farquharsoni*] series—the ones with the "rugose" larva with the lichenoid colouring.

Feb. 14, 1918.—I hope my last little collection gets home, especially as one of the *Argiolaus*, type E [F had been written, evidently in error], is a unique one. I haven't a duplicate, and I hope the pupa-cases sent of the C group [*E. farquharsoni*] will reach you all right. They are on natural substrata, as found in the open.

I think I must have accidentally mis-described the Nematode-infested larva, which is one of the B [*A. paneperata*] series of *Loranthus* Lycaenids [see p. 366].

March 2, 1918.—In the box I send you is a tube with the Filariid worms from the B *Loranthus* Lycaenid larva. I also send you duplicate larvae of the B and C series. There are signs of more flowers soon, and I may get some more. The first of the series are home anyhow. I hope the second lot will get there, for it contains the unique E specimen. You will see that I send you still another of the rarer A type [*T. timon*] which is the most beautiful of all, I think.

March 23, 1918.—I think the whole of the *Loranthus* series have got home, and I am waiting as patiently as possible to hear what they are.

April 17, 1918.—I am looking forward to the identification of the *Loranthus* series. It was luck to get them all home, especially as one of them was a unique specimen. I'll prepare herbarium specimens of the host-plant when it flowers again. It is not a pubescent species, but has thick, "cold," almost succulent leaves, which are quite glabrous. So also are the flowers.

April 28, 1918.—I duly received your long letter with all the details about the *Loranthus* Lycaenids. The host-plant is just coming into flower, and I will make a point of getting material for Kew. In spite of a certain dissimilarity of the larvae, there is an unmistakable broad similarity, and I suppose the genera are nearly related.

May 28, 1918.—I am busy getting ready to hand over to the Director of Agriculture, who is now on his way out, and have only time for a short note about a parcel I send you by this mail. There is nothing of any consequence in it. I have sent an extra lot of the B series [*A. paneperata*] of the *Loranthus* Lycaenids, of which so many came out that I got the numbers mixed so I have not the cases. My stock of tins was too limited to give them all extra boxes. However, I send them really to see how the sex proportion will turn out. The B species is, I think, the commonest of all, then the D [*Epamera iasis*]. The "gall," *A. maesa*, and *alcibiades* are not uncommon either. They *are*, of course, if one doesn't know where to find their larvae, practically all *uncommon*.

The larvae are all quite distinct, and yet there is a general similarity of shape and in "poise," also of the pupae. The pupae of C [*E. farquharsoni*] and of the unique specimen E [*E. laon*] are really very similar, as are their larvae, although widely different in colour. Their shape is not so very different from the "gall" larva, but is very different from either A—*Tanuetheira timon* (a nice name and appropriate), or B—*Argiolaus paneperata*. A and B larvae are very similar, but differ a little anteriorly in A larvae having an extra pair of little prominences. Both are of the same dull green colour.

D [*E. iasis*] rather differs, though its shape (larval) is to my mind strongly reminiscent of B. Its colour varies from yellow-orange to red (the red of a Bryant and May non-safety match). Its pupa, though differing in colour, yet to me recalls B, especially, and B's pupa again is just like a small *alcibiades*. The larvae of *alcibiades* are like very large B larvae. As I have said above, to my thinking the larvae of C, E and *maesa* form a natural group. I can assure you that I could not mistake the larva of any one of them for that of any other. The pupae are also distinct. The only two that I might confuse as pupae would be C and E. The "decorated" pupa F is extremely reminiscent of B, and, by the way, its larva, which I didn't get this time but got once before, is to my recollection very like that of B and at the moment I cannot recall how to distinguish them. The affinities of the series to me then may be represented thus:—

$$\text{Group I}\ \left\{\begin{array}{l}\text{A } [\textit{T. timon}]\\ \text{B } [\textit{A. paneperata}]\\ \text{F } [\textit{A. iulus}]\\ \text{G } [\textit{A. alcibiades}]\\ \text{D } [\textit{E. iasis}]\end{array}\right\}\ \text{especially A, B and F.}$$

Group II
C [*E. farquharsoni*]
E [*E. laon*]
A. maesa.

[The above-mentioned eight species are all included in *Iolaus* by Aurivillius (Rhop. Aethiop., p. 546), whose order is followed on pp. 361–63, although the genera of other systematists are accepted. To become consistent with these, *Argiolaus maesa* should change places with *Epamera iasis* in Farquharson's groups, thus bringing together all the species of each genus. Farquharson considered that the pupa of *iasis* resembled that of *paneperata*, but the single example sent is clearly the short pupa of an *Epamera* with the characteristic position. The pupa of *A. maesa* is greatly modified, and its affinity obscured by its extraordinary resemblance to a gall. The bud-like pupa of *T. timon* is of a very different shape from that of *Argiolaus*. Farquharson's material and observations taken as a whole appear to me to support the validity of the three genera *Tanuetheira*, *Argiolaus* and *Epamera*.]

Aug. 11, 1918.—I think you will have got my letter in which I attempted to relate the members of the *Loranthus* complex according to larval characters. I think *Epamera* was my expectation. Before I leave these, I think I said before that these larvae are *not* ant-attended. The particular *Loranthus* is a parasite on a *Funtumia elastica* about fifty yards from the *Cremastogaster-Alstonia*, from whose numerous *Loranthus* parasites the "gall" comes very commonly. But on the *Funtumia-Loranthus* there are practically no ants at all, except a few *Pheidole*, which absolutely ignore the larvae. I am certain that I never found one larva attended by ants on that tree. Now, oddly enough, not twenty feet from the *Alstonia* is another *Funtumia* (same species) with a gorgeous specimen of the same *Loranthus* on it. It is simply infested with *Cremastogaster*. It is from it that I took the specimens for Kew, and though I have searched again and again at the same time as I was getting larvae from the other *Loranthus*, I never found a single larva on it. Yet *alcibiades* and *maesa* regularly come down the *Cremastogaster*-infested trunk of the *Alstonia* to get away from the tree for pupation, but they are, I think, left alone, till pupation at least. Not infrequently I have seen cases where the larva had pupated on a weed too near the tree, and the ants had discovered the pupa and destroyed it.

Aug. 12, 1918.—I have posted two parcels, one containing a flowering specimen—in spirit—of the *Argiolaus-Loranthus* [*L. incanus* Schum. and Thonn.]. I shall get fruits later.

10. *An "Electric" Sensation caused by handling the Larvae of Argiolaus and allied Genera.*

Dec. 27, 1917.—Xmas here was a very quiet time. I spent all of it, except the evening, in the open and was on the whole rewarded. I made a curious discovery in handling two (species, I think) of the *Loranthus* larvae. These larvae are of very characteristic shape, which is difficult to describe. They are rather Molluscoid or Limacoid than onisciform, though they are smooth except at the margin, which is minutely bristly, doubtless to protect the feet. The "carapace" besides comes right down so that the feet are not visible. In section the larvae are more or less triangular. The posterior part is bilobed, and in one of the species there are little lobes anteriorly. They have tubercles, exserted very rarely, but if they have a gland it is hard to see. I recall my note above [pp. 369, 370] on the absence of attendant ants in view of what I am about to tell you, which I had not observed before. These larvae are relatively large so that it is possible to lift them between the finger and thumb towards the anterior end, and without the skin of the fingers coming in contact with the marginal overfold. In handling one of these, I suddenly was conscious of a curious sensation in my finger and thumb which is very difficult of description. As near as possible it reminded me of a very faint electric shock, not accompanied by a prickly sensation but rather as if one were being tickled by a tiny brush of slightly strong bristles. Now the skin of the finger and thumb, or the parts used in handling a small object is fairly hard and not over-sensitive. I doubt if mere surface mechanical irritation by minute bristles, which I cannot detect even with a ×10 Zeiss pocket lens, could have produced the effect. The sensation was not that of tickling so much as that of a faint shock, which was not continuous but rapidly intermittent. The skin of the larva is covered with yellow dots, very minute and scarcely visible to the unaided eye, like glandular dots on a leaf. To make sure that the whole thing was not illusion I got my boy to hold one and to say if he felt anything. He replied in good "pidgin"—"he scratch my hand," by which I think he meant tickles. At any rate, so far as I can make out, there is nothing on the larval epidermis to scratch anybody's hand. On putting the larva down there was no after-sensation which hardly indicates stinging. I had another larva very similar in appearance but a different species—if anything smoother. I thought at first that it had not the same property. I tried it on the boy and he felt it. I tried it again myself, but though it was rather less pronounced than the other, there was no question about it responding in the same way. I will put up spirit material and perhaps Dr. Eltringham will investigate the nature of the gland-cells, for I'm sure the minute yellowish dots are the seat of the response, whatever its nature. I myself believe it to be electrical. I find it hard to say why, except that it reminds me of nothing else so much as the queer " internal " tickling that a faint discharge produces. " Internal " is the only adjective I can think of, meaning thereby that the sensation is felt up the inside of the finger, as it were, rather than on the surface, like tickling, in fact. I do not know the vocabulary of experimental psychology, but perhaps you see what I am trying to get at. The cryptically coloured, knobby larva [of *E. farquharsoni*] does not possess the property. I have got, I think, ten of these now, but none so far have pupated.

Dec. 29, 1917.—The larva [of *E. farquharsoni*] *is* slightly " electric " also, perceptibly so in well-grown larvae. *Tanuetheira timon* is the form with the most markedly " electric " larva.

March 23, 1918.—I thought of an electroscope, but I fear that is beyond my reach, though I may manage to borrow one at the High School in Lagos.

[Dr. Eltringham is inclined to think that the " electric " sensation may be caused by a shivering motion of the larva, causing the rough cuticle to vibrate against the skin: pp. 484–85.]

B. NOTES ON THE LIFE-HISTORY OF TWO SPECIES OF DEUDORIX AND ONE OF CATOCHRYSOPS WHICH BORE IN THE PODS OF CANAVALIA ENSIFORMIS D. C. (LEGUMINOSAE).

[The following material illustrates the notes :—

1. *Deudorix antalus* Hopff.—2 ♂ 5 ♀, emerging Feb. 19–23, 1918, and 1 ♀ March 1. Each of the former 7 is

accompanied by its precise pupa-case. Also from larvae collected on *Canavalia* at Agege—3 ♂ 1 ♀, emerging March 2–7.

2. *Deudorix odana* H. H. Druce.—1 ♂ 2 ♀, emerging Feb. 21–22, 1918; each with its precise pupa-case, that of the ♀ of Feb. 22 remaining in a tightly rolled leaf or pod, bearing Farquharson's note—"butterfly somehow managed to emerge." In spite of the very small opening it is a fine specimen. The larva must closely resemble that of *antalus*, for this keen and most observant naturalist thought he was dealing with a single species of large larva and accordingly labelled both with a single series of letters following the order of emergence. He would of course have detected the difference between the butterflies, but there is no doubt that these were packed off at once without examination. Farquharson's is the first record of the early stages of the species. Although the male of *odana* appears to be common—Lamborn took a fine series at Oni—the female has rarely been seen; indeed, I only know of two other examples, both in the collection of Mr. Bethune-Baker, who has now kindly drawn up a short description of this sex and added a note on the variation of the species (p. 463).

3. *Catochrysops malathana* Boisd.—1 ♂, emerging Feb. 19, 1918; accompanied by its pupa-case. Also bred by W. A. Lamborn from a Leguminous pod and sent accompanied by attendant ants (Trans. Ent. Soc., 1913, p. 488).]

Feb. 4, 1918.—The Harmattan is very strong just now and insect life is hardly at its maximum activity. In fact things are hard to get. I drew a complete blank yesterday—my Sunday—much to my disgust. However, this evening things brightened a little. I got a *Pterocarpus* larva [p. 385]. I think they are about to appear, and I took it into my head to look for a *Catochrysops* on a bean we grow here, *Canavalia gladiata*—or *ensiformis* I believe it is—: I'll look it up, in view of the possibility of a revision of the genus. Lamborn, I remember, bred one out of the pods of the Pigeon Pea, *Cajanus indicus*, here, which he told me was *C. malathana*. I remember it went to the B.M., being an official matter, and if my memory serves me aright, he learnt to his surprise that it was something else, something or other *boetica*, I think, but the B.M. will be able to tell you. I pass *Canavalia* plots every day and I have looked casually at them too without result, but other things were trumps just then, such as *Argiolaus*. But I was driven to concentrate on it to-night. Virtue had its own reward! I have got two species of Lycaenids, one I think a *Catochrysops*, the other looks rather more like my *Pterocarpus* friends, but I'm not really sure. I don't know it anyhow, and it's a fairly useful-looking larva—not a tiny form. I've got six and I'll get more now I know where to find them. Mr. Massee, who saw more in the field than ten average men, used to quote to me a saying of M. C. Cooke's which was something like this: "If you can't find a thing (that you have reason to think ought to be there) sit down till you do find it." It isn't bad advice, if one really has the luck to have good eyesight and something of a field instinct. I've got the eyesight all right, but as for the field instinct—well I must touch wood. The more I find the more I marvel how I missed the things so long. The little bush we have left here and the Harmattan together have reduced me to a "field" of 4 or 5 ant-trees.

Feb. 5, 1918.—*Canavalia* is of the family Leguminosae. The species on which I find the Lycaenids is, I think, native, but it is one widely cultivated in the Old and New World tropics, and ours are actually grown from introduced seed. Yet a wild form (if it isn't a distinct species) is common round here.

There are without doubt two Lycaenids concerned, both boring into the pod—one a typically onisciform one which I think will prove to be "*malathana*;" but the other is very different—a plump, rather large larva that at first sight suggests a slightly pigmented Coleopterous larva or an Aegeriid. I was at a loss to recall what they did resemble more than Coleopterous larvae. Then I recalled the Aegeriids and had a spasm of doubt; but there *is* a gland, though it doesn't seem to function often, but the larvae are attended inside the borings by a tiny ant like a rather dark-coloured *Monomorium*. But the larva bores right inside the large bean: it is bigger or at least fatter than a broad bean, and the presence of larvae is indicated either by fresh frass round the opening or by a busy little crowd of ants running in and out. The little ant is always on the plants, larvae or no larvae, the inflorescence being very glandular. In addition a Jassid is present in small numbers. The larva is really quite Aegeriid-like, of a straw-colour generally, but with the anterior segment bright red, and rows of brownish purple spots along the sides. It is, however, slightly bristly, recalling one at least of the *Pterocarpus* forms, only much larger. It must be quite a large species, or it is a horrid deception. We have the bean planted all over the place as a cover crop, but I have so far found the larvae only in the heavily shaded riverside plots. But in these there are abundant traces of their activities in the shape of holes, although I haven't met with a single pupa. The plots are clear of weeds, so that if they leave the host-plant for pupation they must travel a good way. Some of my larvae I am sure are replete and will pupate in a day or two.

Feb. 6, 1918.—The new larvae didn't pupate; I think it was a moult-rest, for they were all active this morning. I cannot see a trace of tubercles, but I am sure there is a Guenée opening, though the gland doesn't seem to function. Somehow I shall be glad when one goes up, for the larvae are rather odd in more respects than one. When feeding they are short and fat, but on the move they are quite long, longer than any Lycaenid larva I have yet met, and extremely Aegeriid-like except for the concealed head, which, however, is thrust out when they are full-stretched and walking. But a short and rather stout pro-leg process (p. 352) is present which is rather reassuring. The spots are rather variable in colour—purple-brown, I think, only in the younger larvae. More mature larvae have the spots a very unusual indigo-blue colour. The rather striking pigmentation, blue spots on a straw-coloured "ground" with a red head, is odd in a boring larva.

A few Sundays ago [Dec. 8, 1917: see p. 325] I saw a very recently emerged (but flying) and perfectly gorgeous, tailed "Copper" on the edge of a *Canavalia* plot where I have got several larvae. I am wondering if it may not be the one I'm on the track of, but I'll just have to possess my soul in patience. But I did tell that "Copper," with no little fervour, how much I'd like to see her oviposit on something. She didn't oblige, however.

Leguminosae seem to be favourite food-plants of the [Lycaenid] "herbivora" and "anthophaga." As a matter of fact, I *had* looked at the flowers of *Canavalia* two or three weeks ago, but drew a blank and only came to look at the fruits in case of a *Catochrysops* having taken an interest in the plant.

March 2, 1918.—By this mail I am sending you a small box with the *Canavalia ensiformis* Lycaenids. Only one of the small forms has come out so far. I have a few to come, reared from the same plant at Agege, just to find out if there is any difference. They are fine large forms, rather resembling the famous "*Camponotus maculatus*" form [*Catochrysops phasma*, p. 392]. I have sent you the pupa-cases also. They have a most distinct silk girdle placed about the middle of the body. I was disappointed to find that it was not the gorgeous "Copper," but I may get these one day.

C. Notes on three Lycaeninae, their Parasites, and two Moths, feeding on the Ant-infested Flowers of Pterocarpus esculenta Schum. and Thonn. (Leguminosae).

[The following material illustrates Farquharson's notes :—

I. Lepidoptera.

1. *Deudorix* (*Pilodeudorix*) *diyllus* Hew.—10 ♂ 9 ♀, emerging March 11–20, 1917, each of the first 10 with its precise pupa-case. Emergence takes place about 8.0 or 9.0 a.m., as may be inferred from the following data on the labels: 8.0 — ♀; about 8.0 — ♂; after 8.0 — ♀♀; after 8.30 — ♂ ♀; 9.0 — ♂. An example of the larva, which is distinguished from that of *camerona* by its more tuberculate appearance, is figured by Dr. Eltringham on Pl. XIII, fig. 14, p. 484; and a ♂ pupa on Pl. XIII, fig. 8, p. 484. The pupa resembles on a small scale those of *Deudorix antalus* and *odana*. The female imagines of this species and *camerona* are briefly described by Mr. Bethune-Baker on p. 464.

2. *Deudorix* (*Pilodeudorix*) *camerona* Plötz.—2 ♂ 2 ♀, emerging March 15–18, 1917, a ♀ of March 15, "after 8.30 a.m." A ♂, March 16, bears the note "? Less tuberculate larva," and a ♀, March 18—"Smooth larva."

3. *Lycaenesthes musagetes* Holl.—1 ♀, emerging March 18, 1917. It bears the note "From green onisciform larva." The early stages of this species, as of *diyllus* and *camerona*, were unknown.

For a preliminary announcement of the breeding of these three Lycaenidae see Proc. Ent. Soc., 1917, p. lxi.

4. *Maruca testulalis* Hübn.: *Pyralidae*, *Pyraustinae*.—1, emerging March 13, 1917. A moth of world-wide distribution.

5. *Olethreutes* sp. nr. *wahlbergiana* Z.: *Tortricidae*.—1, emerging March 11, 1917.

II. Diptera.

6. *Exorista poultoni* Villen., sp. n.: *Tachinidae.*—1 ♂, bearing the note "Ex *Pterocarpus* Lycaenid." The date was some time in March, 1917. This brilliant black species has been kindly described by Dr. Villeneuve on p. 518. This fly and the following Ichneumonid were parasitic on one of the species of *Deudorix*, probably *diyllus.*

III. Hymenoptera.

7. *Adelotropis farquharsoni* Waterston, gen. et sp. n.: *Ichneumonidae, Joppinae.* — Bearing the note "From *Pterocarpus* Lycaenid. 22.iii.1917." Described by Dr. J. Waterston on pp. 455–58.—E.B.P.]

Feb. 27, 1917.—I was in luck's way on Sunday. . . . Just lately the orange-yellow blossoms of a small tree that grows along the river-bank, at times with its roots entirely in the water, have been very conspicuous. The tree I was told was a species of *Pterocarpus.* To verify this and to get a nearer view I went down to one of the more accessible specimens. [The presence of an empty pupa of *Argiolaus* type just below the tree, as alluded to on p. 366,] led me to look rather closely at the *Pterocarpus,* the first non-botanical feature observed being the presence of *Oecophylla* nests, and workers running about the leaves and inflorescences. I pulled down a flower-bearing branch very gently, it was the only one within reach and had to be carefully handled. *Oecophylla* is a jealous animal, ὑβριστικόν τι. Then I saw what I took to be a Limacod larva, not so brightly coloured as these usually are nor the characteristic green or yellow, but spiny and tuberculate and of a russet colour not unlike that of a withered *Pterocarpus* flower. Two ants were running about the inflorescence, but up to this point I didn't associate them with the larva. I was in two minds whether I could spare the time to breed out a Limacod (the larva was, for one of these, rather small and doubtless young), and for some obscure reason decided to take it in. I shook the ants off the flower and did so. Force of habit made me examine its wonderful armament with a lens, and I thought I detected a pronounced non-Limacod character. I soon satisfied myself that it had tubercles and a Guenée gland. Very soon I had in the tin a more discerning *Oecophylla,* which made straight for the gland and tickled it in a way that an *Oecophylla* doesn't usually tickle other animals. I couldn't reach another inflorescence, so hastened home for a more leisurely study. What I believe to have been a Psyllid jumped off the flower, but I thought there would perhaps be others concealed among the flowers, which are rather crowded. In this, as it turned out, I was disappointed. I got out Lamborn on the "Relationships," [Trans. Ent. Soc., 1913, p. 436], and decided that I'd got hold of a larva not unlike that of *Megalopalpus zymna*, with a new attendant ant perhaps. I noticed that the pro-legs had the curious little protrusible "sucker" that I have seen in *Hewitsonia* larvae and in others of the "hairy" group, though this one is not of that type at all, being sluggish in its movements and of onisciform habit (but for the tubercles and spines, with the overlapping "carapace" concealing the legs), and while intently watching these details through the glass cover of the little box in which I'd put it, noticed for the first time that it was not a "carnivore," but was contentedly devouring the corolla of one of the flowers forming the inflorescence, just like any ordinary, common, garden caterpillar. I had a further search through the "Relationships" to see if any spiny form described by Lamborn had such comparatively refined tastes, but found, unless I have overlooked some detail, that his were very gross feeders and that some had in fact been guilty of the "basest ingratitude," for reasons well set forth therein. But I cannot persuade myself that he didn't find this one, if not at Oni, perhaps here. I have since managed to get one or two more, but none have so far pupated. But I am fairly hopeful unless something goes wrong.

Feb. 28, 1917.—I rather think one or two of my *Pterocarpus* Lycaenids are about to "go up." If not they are about to "go West."

I have had a further study of the larvae. Their colour is not the simple russet that I supposed, for on closer examination with a lens and by the microscope (reflected light) I find that there are little areas of a sort of olive-green colour and others of such light brown as almost to be yellow. The very young larva is, however, pale straw-coloured. The larva is very sluggish, and I got a good view of the tubercles in action with the aid of the microscope. The tubercle of this species, at any rate, is not an organ thrust out through an orifice. It is rather a diverticulum of the epidermis (though other layers may be involved) which is invaginated and exserted alternately. It is crowned by minute "tentacles," which so far as I can make out are not distinct hairs but are produced by a lobing of the upper part of the tubercle. I could not actually detect any orifice, these tentacles being so numerous. Very likely their structure has all been written up, but it may interest you to get this impression of a study of the living larva. I am a poor artist, but I'll try to express my meaning in a rough sketch. The invagination appeared to me to be aptly comparable to the effect produced by one in turning a stocking inside out (the initial stage) or a glove finger.

I am afraid my sketches are hopeless, but when the tubercle is completely retracted the position of the tubercle shows a slight pit with a "pursed" centre. Looking down on the point by reflected light it had a curious resemblance to a starch grain under high magnification, rather like this [sketch]. The extrusion of the tubercles was rather spasmodic. I could not, of course, study it with an *Oecophylla* in situ, for freedom was more attractive to the ant than the Guenée gland. Sometimes the tubercles would continue invaginating and being extruded rapidly for a short space of time and then stop, to be resumed after a bit. I hope to study the movements more in the next few days.

March 1, 1917.—One of my *Pterocarpus* Lycaenid larvae pupated to-day. Another was on the way, and I was wondering why it didn't, when I noticed an "injury" just behind the head on the dorsal surface. I soon discovered the cause, for a wretched Tachinid puparium was lying in the tin and I very nearly overlooked it. It has struck me that this particular Tachinid has made an unlucky or at least risky selection of a host; for the tree always overhangs the river completely, and if the emerging larva is unable to freeze on to anything it would stand a mighty chance of a watery grave. The Lycaenid itself might have done better, for the inflorescences appear to provide food for two or three moths, a beetle, Psyllids and possibly other things, and can't possibly mature many fruits. So hopelessly damaged are some of the flower-heads that what is left is almost sure to drop off into the water. I haven't seen the Lycaenid pupae in the open yet, and the one I have is simply lying loose in the box. It didn't manage to stick on to anything. It possibly hangs or sticks on to the withering inflorescence of which the calyces at least are persistent, which may explain the minutely spinose pupa-case, though this character may quite as well be protective, for the inflorescence is not very tomentose, at least what remains of it when the withered corolla falls off. . . . I am curious to see the next pupa. The one I have now is mottled with small dark green (?) spots, with a brownish ground, and would be very inconspicuous among half-withered vegetation.

March 9, 1917.—I will be able next mail to send the *Pterocarpus* Lycaenid (or two perhaps, for I'm not sure, but I'm dealing with two very similar-looking larvae) along with the others. The first of these ought to come out to-morrow or Sunday. Two are tachinised. Now I must stop this unwieldy letter. I hope I have escaped the Scylla of mal-observation and the horrid Charybdis of bad philosophy. At any rate, I'll make certain that I have a very good box of material for next mail. I think I'll send it in two lots in case one lot gets torpedoed. The *Pterocarpus* flowering is just getting finished, and I won't get more material there for a time.

The *Pterocarpus* pupa has a girdle fixing it to the surface it pupates on. In the case of the first pupa I must have accidentally broken this in clearing away the remains of the food-plant and excreta.

March 11, 1917.—Two of my *Pterocarpus* Lycaenids emerged to-day. For the size of the larva, which is relatively large, the imago is very small, with small tails on the hind-wings. The first one emerged about 9 a.m., just before I started on my usual hunt. It was not out at 8.30 when I finished breakfast. In the interval I was getting tins ready for the foray. I did not see the second Lycaenid emerge, for I did not get back till a little after noon, very thirsty, very hot, but fairly well satisfied.

March 18, 1917.—I have now got about 20 imagines of the *Pterocarpus* Lycaenid or Lycaenids, for I think there are at least two and possibly three, unless the larva is a variable thing. I will write details with the specimens.

March 2, 1918.—For some obscure reason I have so far drawn blank in *Pterocarpus*, finding only three larvae, all of which I lost, one parasitised, the others by mould, I think. [One larva, taken Feb. 4, 1918, is mentioned on p. 378.]

D. NOTES ON THE LARVA OF LYCAENESTHES LUNULATA TRIM., FEEDING ON BERLINIA SP. (LEGUMINOSAE).

[The material consists of 6 ♂ and 2 ♀ imagines, all of which emerged Jan. 8, 1918.]

Dec. 29, 1917.—I got a solitary *Pterocarpus* larva to-day; the trees are just beginning to flower. I also made a gathering from a plant that I cannot as yet identify. The young leaves when first they open are a light reddish-purple colour—a very common form of young foliage in this part of the world. As they get older the leaves get tinged with green and finally green. I have a series of larvae coloured appropriately to the different stages, some being pale reddish purple, some the same but tinged with green, and some are bright green. I rather think they are all one thing, for the shape is rather characteristic, an unusually large onisciform type and rather flat, with gland and tubercles and attended by a *Pheidole*—vigorously attended.

Jan. 12, 1918.—There is no doubt these larvae adapt their colour to the food-plant, some being green, some red. So also does one of the *Loranthus* larvae [*Epamera iasis*, p. 372; also a Labiate-feeding Lycaenid larva—pp. 400–401].

Jan. 26, 1918.—The *Berlinia* series all emerged on the same day. I couldn't separate the cases as they " went up " before I could separate them in the tin, but I'll get more.

Feb. 5, 1918.—In case I forget to mention it, *Berlinia* belongs to the Leguminosae, the species on which I found the Lycaenid being a large rain-forest tree *typically*, but here growing by the river-side.

Aug. 11, 1918.—I have been looking for more larvae on *Berlinia*, but the trees have no young foliage at present. The larvae do not eat the old hard leaves. There will be no difficulty, however, about getting them later on.

[The trees were still the same on Aug. 25, when the statement was repeated that " the larvae certainly vary from red to green."]

E. THE LARVA OF LYCAENESTHES CRAWSHAYI BUTL., FEEDING ON CASSIA ALATA L. (LEGUMINOSAE).

[Material:—1 ♂ 3 ♀ of *L. crawshayi*, emerging March 21–22, 1917: also a dwarfed ♀, probably of this species, with its pupa-case, from a larva found on the stem of *Antiaris africana*, at Agege.]

March 18, 1917.—I have also some other Lycaenid larvae at present, off *Cassia alata*. I think Lamborn had these too when he was here. They are, I think, vegetarians, though the plant is covered with Jassids.

Agege.

Sept. 27, 1917.—I forgot to mention that I found a tiny Lycaenid larva on a *Cremastogaster-Hewitsonia-Argiolaus*-tree here, which pupated—the tiniest butterfly pupa I've ever seen. I hope it will emerge all right. I must tell you of it later, as the boy must now run to catch a little local train from Agege to Lagos.

Moor Plantation.

April 17, 1918.—I am a little surprised to hear that the tiny *Antiaris* Lycaenid may be the same as the *Berlinia* one; the pupa-case *and* the larva were really rather different. [Relying upon memory I had, by a slip, written *Berlinia* instead of *Cassia alata*.]

F. THE LARVA OF TRICLEMA LAMIAS HEW., FEEDING ON THE COCCID LECANIUM (SAISSETIA), ON IMBRICARIA MAXIMA POIR. (SAPOTACEAE).

[The material received is as follows:—

1. *Triclema lamias* Hew.—1 ♂, emerging Dec. 25, 1917; pupation Dec. 15–17. The specimen is accompanied by its pupa-case, also by the case of an example (pupation Dec. 15–17; emergence Dec. 24) not itself received.

2. *Lecanium* (*Saissetia*) *farquharsoni* Newst., sp. n. (p. 530).—♀ adults, old and young, together with nymphs. The attendant ants were not received.]

Dec. 13, 1917.—"I've just come back from my evening stroll. I went down to our old haunt (Lamborn's and mine) to look into the welfare of two Lycaenid larvae that have, for the last few days, been slowly devouring a happy family of Coccidae (? *Lecanium*) on a young plant of *Imbricaria maxima*. Of them more anon." [Quoted from Proc. Ent. Soc., 1918, p. xxx.]

Dec. 24, 1917.—The two Coccid-eating larvae that I found on *Imbricaria maxima* pupated in my absence in Agege last week-end. The first emerged to-day. I have an idea that it is very near Lamborn's *L. lachares*.* The upper surface of the wings is black, the under of a pattern very like that of *lachares*. I have spirit material of the Coccids and have attendant ants. The other imago will emerge to-morrow. The larva was green (dull), onisciform, with just a hint of a white line along the edge of the mantle and a slightly lighter mid-dorsal line. There was a gland, but I could not see any sign of tubercles.

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* The under surface pattern is, as Farquharson wrote, very like that of *L. lachares*. The genera *Triclema* and *Lycaenesthes* are closely allied. Aurivillius groups all the species under the latter genus.—E.B.P.

Aug. 11, 1918.—Before I forget I must clear up the point about the *Imbricaria*-Coccid-eater. The larvae were not fully fed when I collected them. Fearing that I might lose them, I cut off a twig with the Coccids on it, and completed the life-history in my house. [This was in answer to a letter in which I pointed out the extreme interest of the observation and the importance of confirming it. Lamborn had shown that the larvae of the allied *T. lucretilis* Hew. is associated with Coccid-tending ants, but did not think that they were carnivorous (Trans. Ent. Soc., 1913, p. 486). Farquharson's notes suggested further observation of this latter species. Lamborn had seen the larvae eating the dark green cortex of a soft plant, but at some later stage they may have attacked the ant-tended Coccids he found in tunnels in the same stems.]

G. THE LARVA OF LACHNOCNEMA BIBULUS F., FEEDING ON SECRETION OF IMMATURE ANT-ATTENDED MEMBRACIDS AND ON LIVING MEMBRACIDS AND JASSIDS: ITS PUPA ATTENDED BY CAMPONOTUS.

[1. The material of the 1915 note :—

Lachnocnema bibulus F.—1 ♀ (var. with quadrate pale spot outside end of F.W. cell), emerging June 4, 1915; with pupa-case, and a ☿ of *Camponotus maculatus* F., sub-sp. *melanocnemis* Santschi, bearing note " Actual ant found in association with Lycaenid pupa." Many additional workers were sent: see p. 423.]

July 3, 1915.—No. 5 is a Lycaenid about which I am very curious to hear. I found the pupa near an exit of the large *Camponotus* var. [nest : see p. 423], with the ant 5*b* apparently stroking it with its antennae. This may have been accidental. You will be able to judge when you see the Lycaenid (if it reaches you safely), for it may be one described, as regards its relationships, by Lamborn. Till I hear from you on this point I will make no further comment. 5*a* is its pupa-case.

[2. The material of the 1917 and 1918 notes :—

Lachnocnema bibulus.—2 ♂ 3 ♀. One ♂ and one ♀ pupated March 13, 1917, and emerged March 22; a second female emerged on the same day, all 3 with precise pupa-cases; a third female emerged at Ogo, March 25. The first-mentioned female bears the note "Larva on secretion of ant-attended immature Membracids on small Leguminous shrub," the other specimens a shortened form of the same. The second ♂ emerged Jan. 4, 1918. It is accompanied by its case and the note "Jassid-eater. New series, formerly found eating Membracids (1917)."

The attacks of this larva upon ant-tended *Jassidae* are described by Lamborn (Trans. Ent. Soc., 1913, pp. 470–1), and he thought, but was not sure, that the ants fed it. Farquharson's notes add greatly to our knowledge of the larval habits and food. For a brief preliminary statement see Proc. Ent. Soc., 1917, p. lxi.]

March 11, 1917.—I have seen another Lycaenid, probably one of those found by Lamborn, but perhaps my observations may complement or corroborate his. This one is part of a Membracid association along with a small black ant that habitually lives in the débris that collects in Oil Palm heads but forages down below. I once had two fine nests of them last year, many of the callows having mite "balancer" parasites. I lost the lot owing to my having to go travelling, most inopportunely, but I hope to do more on them later. They are probably a *Pheidole*. The Membracids (adults and nymphs) I found in a small Leguminous shrub at the base of a Palm, I think a *Tephrosia*, but it isn't flowering and I'm not quite sure. At any rate, it is the host of a very large number of Membracids, a much larger number of ants, and a few Lycaenid larvae. The larva, so far as I can make out, is without Guenée's gland and tubercles. It is rather bristly; the head protected by the usual "carapace." Its colour is a curious blend of the Membracid colour with additions. In appearance it reminded me very much of a large Syrphid larva that I found in Shagamu last tour eating Aphids, and that larva resembled a bird-dropping more than anything else. The young larva is rather more bristly than the older ones and is less "ornithoscatoid." The little shrub is only about three feet high, and I could sit down more or less comfortably to see what they were doing. In the forenoon I couldn't make out what they really were doing. I remembered enough of the "Relationships" to expect to see a few trustful Membracids callously devoured, but failed to see the murder done. Then I went the round of other interesting trees and so home. In the evening I went back, having read up *Megalopalpus* about six times [Trans. Ent. Soc., 1913, p. 458]. After sitting for the best part of an hour with about twenty or more ants in most hostile association with each of my hands, one holding the branch and the other the shrub, I came to one or two conclusions.

In the first place, I failed entirely to find out what the adult Membracid gives to the ants, and, as far as this afternoon's work goes, I am inclined to believe that they give nothing at all. The species, whatever it is, is rather tame, and I had no difficulty in watching both them and the ants.

Secondly, the particular larvae that I watched this afternoon made no attempt to eat the Membracids. The adults wouldn't wait, I imagine, to be eaten, but the relation of the Lycaenid larva to the Membracid, was with the larval stage of the latter, and that I saw as clearly as possible.

The Lycaenid larva is very sluggish in its movements and hardly moved an inch from where it was when I came, all the time I remained. Whenever a Membracid larva came near it got busy and so did the ants. They all got busy in the same quarter, which was the upturned, retroussé end of the abdomen from which at fairly rapid intervals a short process was thrust out, on the top of which a clear droplet was simultaneously visible and instantaneously mopped up by the most enterprising of the suitors, which was generally the Lycaenid, in virtue of its superior size. Along with one or two ants it tickled with its anterior true legs the business end of the Membracid, but by " lolling " (in contrast with the extremely active habits of the ants), in a gross and unmannerly way, right over the orifice, it hardly gave the ants a chance. When an ant did get there first it generally shared, by regurgitation, the good thing with a fellow, and I am inclined to think on one or two occasions with the less gracious Lycaenid. But they showed no ill feeling if the latter got there first, and though all the time they kept biting me with great vigour—though the bite is little more than a fairly sharp prickling sensation—they showed no disposition to attack the Lycaenid. That is as far as I have got with this particular larva. I saw a mature ♀ Membracid ovipositing exactly in the manner described by Lamborn [*ibid.*, pp. 495–97]. I saw two empty Lycaenid pupa-cases on the shrub, which annoyed me because I had missed them. I do not think it would be possible to feed such a larva in the house, as the Membracid probably wouldn't thrive on a cut twig.

One would think that it would be a long time before a comparatively large larva would mature on such fare, and yet it is probably a more concentrated food than many caterpillars get. In connection with the food of the "*Hewitsonia*" type of bark-frequenters [pp. 342–46] I have been examining the frass of various larvae microscopically, and it is to me a great wonder what they take out of the ingested matter. There is no question but what they feed on the "cortex," by which I mean just the thinnest superficial layer (including epiphytic Algae, etc.), for their bites are not visible to the naked eye, nor have I picked them up with a lens. The *Pterocarpus* larvae [p. 383] passed abundant frass which was practically unchanged corolla tissue, unchanged as far as the eye could judge. I took in some fairly large moth larvae [p. 407] the other day which were feeding on a fern epiphytic on an Oil Palm. They ate at a great rate and passed frass as quickly. Unless their digestive fluids are very highly concentrated and very rapid in their action, they could hardly take anything out of the plant tissue. So perhaps the Lycaenid with his Membracids is wiser in his generation than these seeming children of light. I hope to get them when about to pupate, to examine their frass too.

March 18, 1917.—I have now got several of the Lycaenids of the Membracid association to pupate. I have paid several visits since first finding the larvae. I'm sure now that Lamborn knew of it, for I recall him asking me if I saw any resemblance to a monkey's face in the pupa. [For Lamborn's observations on *Lachnocnema* see Trans. Ent. Soc., 1913, p. 470; but the supposed resemblance to a monkey's face is in the pupa of *Spalgis*, also proved to be carnivorous by Lamborn and others: *ibid.*, p. 475.] There is that suggestion certainly, but I think, at a little distance off, the effect is much more of the bird-dropping order, in a different way from that of the larva, for the colours are those of brown paper and putty, nicely blended. I tried hard to make more of their relation to the Membracids, but without success. I saw one once again feeding on the droplet but not on the Membracids, but my visits seemed to coincide with resting—probably from repletion—periods. I succeeded, however, in getting several larvae on the point of pupation and have examined the frass microscopically. There could be no doubt about the presence of insect remains in it. I will send some in due course for your confirmation.

I found in one pellet a mass of asci with spores (a type with a mucilaginous covering), but I couldn't find any perithecium, and I cannot suggest as yet what the fungus may be or how it came to be there. It must, I think, have spored before leaving the caterpillar's body, for I put the larvae when found into perfectly dry new pill-boxes, and the pellets are so small and would have dried so quickly that I can hardly believe the fungus spored after extrusion of the pellet. I don't think there can be any doubt but that the larvae do actually eat the Membracids, which is rather low down. But at the same time they feed directly on the secretions of the nymphs. I am still puzzled as to what they or the ants get from the mature Membracids.

Jan. 26, 1918.—I got my Membracid-eater and secretion-drinker eating Jassids, as Lamborn did, on *Cassia alata*, and send one.

H. THE MATURE LARVA AND PUPA OF CATOCHRYSOPS PHASMA BUTL., FROM THE SUBTERRANEAN NEST OF THE ANT CAMPONOTUS MACULATUS F., VAR. MELANOCNEMIS SANTSCHI: ITS YOUNG LARVA FEEDING, WITH THAT OF ANOTHER LYCAENID (PROBABLY EXHIBITING INDIVIDUAL COLOUR-ADJUSTMENT), ON THE FLOWERS OF SOLENOSTEMON OCYMOIDES SCHUM. AND THONN. (LABIATAE).

[Material:—21 ♂ and 18 ♀ *C. phasma*, emerging Sept. 12–25, 1917, from pupae found Sept. 10 in débris of the ants' nest at Agege, 33 with precise pupa-cases. Emergence takes place at about 8.0 a.m. or earlier, as shown by the following data:—about 7.0 a.m.—1 ♀; about 7.15—1 ♀; before 8.0—3 ♂ 3 ♀; about 8.0—2 ♂ 3 ♀. With these, many pupae and two larvae in spirit taken at Agege with the pupae from which the imagines emerged; also Termites of three different genera (see p. 416) from the Termitarium in disused parts of which the *Camponotus* had made its nest. Also, from Moor Plantation, 3 ♀ imagines of *C. phasma*, ovipositing on flowers of *Solenostemon*, Aug. 5, 1918, and (two on the same plant), Aug. 11.

The discovery of the pupae in the *Camponotus* nest was at once brought before the Entomological Society (Proceedings, 1917, p. lxi, and 1918, p. lxxix, where the first determination of the Lycaenid as *parsimon* F. was corrected to *phasma* Butl.

The male armature of the *Catochrysops* has been examined by Dr. T. A. Chapman, F.R.S., and Mr. Bethune-Baker, who agree that the species is certainly *phasma* Butl. For a description of the larva and pupa by Dr. Chapman see pp. 490–93.]

Government Farm, Agege.

Sept. 10, 1917.—I have had a glorious find to-day. I set some men to clear the site of new labourers' lines. I went to see the progress of the work just as they were levelling what I took to be an old ant-hill (Termitary). The species of Termite is one that fastens on to large bush [forest] stumps and gradually converts them into a carton and mud heap, mainly carton, unlike *T. bellicosus* Smeathm., our commonest form, whose hill is entirely of clay. The colony was a feeble one, the material, I suppose, being more or less exhausted. But what I just arrived in time to see was, that in the abandoned carton portion *Camponotus maculatus* had established themselves. A fork thrust had just fetched out a mass of the nest, and amongst the débris I saw a number of pale-brown pupae, obviously Lepidopterous. I must make it clear that this fork-thrust went well below the ground-level, so that these pupae—and I found many more *in situ* in the mass—were actually subterranean, and they are Lycaenid pupae. I have seen the butterfly, for two or three emerged on the spot, a large blue form with spotted undersides and slight tails. The pupae were moth-pupa-like in colour, though rather pale or straw-coloured. I haven't counted, but I think I must have thirty of them, and not a few were accidentally destroyed. They all look as if they would emerge together. And I found two larvae about to pupate! They are of almost wasp-grub appearance, their legs and pro-legs being greatly reduced. I don't think they have either gland or tubercles. They had obviously stopped feeding, and it was useless to try them on the only likely-looking stuff there was, and that was Termite "bread." The nest had to be destroyed—it was ruined really before I arrived—but I think I'll be able to find others.

Do you remember that at Ibadan I once found a brown moth-pupa-like form associated apparently with *Camponotus maculatus* [p. 388]? I rather think you made it out as a somewhat abnormal form of *Lachnocnema bibulus*.

The huge soldiers of *C. maculatus* eagerly seized both pupae and larvae and carried them into concealment in the carton intricacies. I hope I may solve their food, but it may well be that they can tackle fungus growths on abandoned Termite bread left in the galleries. What strikes me as rather extraordinary is that this strange habitat would appear to be a safe one, for I'm sure there were in all fifty pupae, if I could have got them all, and the larva is soft-bodied with but few bristles. Now I will have to let this foreword do. I hope I'll get a good number successfully bred out. I ought to be able to send you the first lot next mail.

Agege.

Sept. 16, 1917.—My find might have been more complete, for I doubt if my first surmise as to the food of the larva is correct. On the whole I think it must be ruled out, but I may manage to get another nest of the kind sooner or later. It is something gained to know where to look. *The* nest was ruined before I came on the scene, and the wonder is I managed to get the material I did. It is all due to the fact that the present labourers' lines here are in the last stage of dilapidation and I determined to have new ones made. I got a new site selected which wanted some levelling. This I set the men to do. One has to be possessed of considerable versatility in a country such as this. I have done many strange jobs this tour, few at my own work. One can't leave the simplest bit of work to chance and a native headman, so after a time I went to see how the work was getting on and arrived in time to see two men driving forks into an old Termitary, part of which was already levelled. Little colonies of Termites with their fungus garden lay in the débris, and running about in great agitation were a large number of workers and soldiers of *Camponotus maculatus*. But what startled me more than these quite usual things was to see scattered about a number of golden-brown or straw-coloured pupae, which at first I concluded must be moth pupae. I concluded mentally that they might be worth having were it only for a seemingly gregarious pupation in rather an odd place. Then, perhaps because just a few minutes earlier

I had noticed a fairly large Lycaenid flying around, it suddenly entered my mind for no considered reason, I must confess, that they were Lycaenids. It was simply an inspiration. Almost simultaneously I saw the agitated *Camponotus* endeavouring to carry them to safety, and further I saw a newly emerged Lycaenid appear from, well nowhere, but I felt sure it was one of them. I saw another and I think a third as I hastened off to get tins, and warned off all labourers from the scene on pain of execution. I didn't get any of the butterflies and not a few of the pupae were badly damaged, but, with the exception of perhaps half a dozen or more that were hopelessly smashed, I took them all in and afterwards found I had brought in forty-one in all! I'm certain there weren't less than fifty pupae in that nest. I could do nothing to restore it and could only search the ruins cautiously for survivors of the wreck. I had great difficulty in separating the ants from the pupae. Two I discovered really by means of the ants. I saw two worker *Camponotus* trying to penetrate into the loose earth. There was no visible opening, but I thought there might be one beneath, and cautiously cleared away the particles of soil. About half an inch below I came on the two pupae. The ants rushed at them and proceeded to extricate them. I appropriated the lot. But I must go back a bit. The Termitary was of the carton type, part of it old and abandoned, and I am pretty certain had become secondarily tenanted by the *Camponotus*, though I couldn't definitely find the centre of the nest. There were neither larvae nor pupae of the *Camponotus*, only workers and the huge soldiers. But I abstracted a large mass of the carton nest and on it put a few pupae. Ants already occupied the carton material. The pupae were immediately seized and carried out of sight into the mass. I searched most carefully for Lycaenid larvae and found two, in loose soil. These also were eagerly carried inside the carton mass. The larvae were apparently replete and resting, prior to pupation. I could detect no glands nor tubercles, though, now they are in spirit, there is evident a slightly pigmented prominence in the region of the Guenée gland. The larvae are, to say the least of it, very grub-like, which is accentuated by their meagre pigmentation. The only colour was a faint pink, so faint as to be almost white. Where they may have been located in the original nest I cannot say. I think it most probable that it was in the carton mass. It *is* a pity that the nest was smashed, but the only consolation is that had it not been smashed I shouldn't have found them. Any future ant-hill smashing that I do will be done most cautiously. Since then I have probed about half a dozen similar ones, but only to find, besides the Termites, colonies of *Odontomachus haematodes*. But, after all, one can hardly expect such finds every day of the week, and I had to wait a long time for *Teratoneura*!

When the ants carried off the pupae and larvae I carefully broke off bits of the carton to see what they had done with them all. I had "allowed" them about half a dozen pupae. I found them all carefully massed together round a dried-out bit of Termite "bread." This led me at first to suggest that as the food of the larva, but on thinking it over I rather doubt it. I am more inclined to think, after looking at the extremely small heads of the larvae, that they are fed by the ants, unless the entire absence of ant larvae be accounted for by the Lycaenids having devoured their ova. That also I doubt. The larvae with glands, as far as I have seen, and I think Lamborn's results show the same, are generally phytophagous, anthophagous or suck sugary secretions. *Camponotus maculatus* I do not think is ever carnivorous, but haunts flowers in search of nectaries, leaf-glands and such-like, and has a perfectly distressing "scent" for one's sugar stores. It is quite likely that they innocently feed the Lycaenids by the ordinary process of regurgitation, and the Lycaenid perhaps does redeem itself from the slur of parasitism by a little return through the medium of the Guenée gland. An examination of the contents of the alimentary canal might throw some light on the subject (see p. 492).

Agege.

Sept. 17, 1917.—Seven emerged to-day or rather eight, the eighth being malformed. I have been most unlucky with malformations, having now about half a dozen. Several more pupae have simply blackened and perished, but till now I have fourteen practically perfect specimens, and I may with luck finish up with two dozen. It is very sad to lose so many, but I'm afraid it couldn't be helped. Anyhow, I don't suppose, since Lamborn's wonderful *Euliphyra* case [Trans. Ent. Soc., 1913, p. 450], so many butterflies have been bred out of a nest of ants. And of course my find was a pure accident, and ought not to be mentioned along with such a wonderful bit of deliberate searching and finding as Lamborn's was. And of course if it hadn't been for Lamborn, the happy issue of this particular accident would have been lost. So I gladly dedicate them to my friend.

I mentioned that I allowed the ants to carry pupae into the concealment of the carton labyrinth, from which I afterwards abstracted most of them. A few I left in the hope that I might see how the ants behaved subsequently. I wondered if they assisted the imagos (or should I say imagines?) to emerge. Unfortunately I have quite a lot of other work to do, and in my absence two or three came out. I got back in time to rescue one which was caught by a leg by a worker ant. What I took to be the disintegrated remains of two I discovered under the carton mass, but they may have been devoured by the white ants which still were present. Later on another got caught by an ant and had to be rescued, and, as I really couldn't get the time to look after them continuously enough to make useful observations, I was forced to separate them entirely from the ants. Yet in nature these newly emerged butterflies would have to run the gauntlet of not a few easily excited and suspicious ants, and I am greatly disappointed at not being able to throw any light on the problem. I can only hope that I may one day see a newly emerged Lycaenid crawling out of the opening of a *maculatus* nest. There will be no scope for "profane" labourers with forks. Escape may be facilitated by the fact that *maculatus* is, as I think I told you [pp. 423–25], of nocturnal habits.

Agege.

Sept. 18, 1917.—Five perfect and one malformed emerged to-day, which brings my total of good specimens up to nineteen. With anything like good luck I ought to manage two dozen and perhaps one or two more. I have to go to Lagos to-morrow and will be there two days. However, I'll take them with me. I am putting up at the Medical Research Institute, where they will be looked after while I carry out the purpose of my visit, which isn't a very exciting one and is on the whole a most irksome one.

Agege.

Sept. 27, 1917.—The mail is announced for to-day. The train service is suspended owing to floods, but I am sending a boy to Lagos with this and a box with a few of the great find. I am so pressed for time that I had to take a few at random from the box. I will send the rest in small lots so that they may not all be torpedoed at one Hun effort. I have also sent one larva and one tube with Termites.

Agege.

Oct. 18, 1917.—I will now give you a few notes of the things I have posted for this mail. To begin with I have sent a second batch of the *maculatus*-Lycaenid with pupa-cases. The boat they will go by is an old and none too speedy one, but one that has had the most wonderful submarine adventures and got through. On one occasion she fought the enemy for six hours, was missed by four torpedoes and sank the enemy. That is no romance—except in the best sense. So I am in hopes that you will get my Lycaenids.

Agege.

Oct. 20, 1917.—I hear the R.M.S. " Mandingo " (originally " Appám ") has got home, and on it were the first of the *maculatus*-Lycaenids.

Moor Plantation.

Jan. 26, 1918.—[After describing the final consignment of *C. phasma.*] Then you got some pupae in spirit which failed to emerge, so you may now total up the lot. And I think you may safely allow ten more for unfortunates that were squashed in digging out the ant-nest, besides the two larvae, and you will know the wonderful total.

Jan. 12, 1918.—A mail arrived here yesterday which brought me a proof copy of the foreword (Proc. Ent. Soc., 1917, p. lxi), and also the news that the *Catochrysops* may *not* after all be " *parsimon*." I hope its real name will be worthy of such an enterprising animal.

April 17, 1918.—*Catochrysops phasma* rather pleases me—much better than " *parsimon*," a dreadful combination of indifferently classical Latin and neglect of observation [see also p. 325].

Aug. 11, 1918.—What with adding up yards of wretched money columns I was in doubt if I could catch the next steamer home. So heartily sick of the work was I that my whole outlook was one of unredeemed pessimism, but the other day something happened which made me wish for another month here at the risk of missing September in

Scotland. I have a milch goat, a somewhat perverse animal. One afternoon it cried so very persistently that I went outside to see what could be wrong. I could find no evidence of anything but perversity, and was really feeling most annoyed, when I suddenly saw a *Catochrysops*-like Lycaenid deliberately oviposit (I felt quite sure about it) on a weed in my compound—a *Labiate!* [*Solenostemon ocymoides* Schum. and Thonn.] The plant is the one from which Lamborn bred *Precis octavia*. It is an almost scentless plant. I knew of *Ocimum viride*, the so-called mosquito-plant, and had looked at it for Lycaenid ova, but without success. *O. viride* is a W. African plant (it yields thymol) the scent of which was supposed to be a mosquitifuge. It is commonly found in native villages. It doesn't seem to have entered the minds of those who boomed this plant as a terror to the mosquito, that the absence of mosquitoes from villages where the plant grew (if indeed they are ever absent) might equally well be due to the normal so-called "bouquet d'Afrique," which at times takes forms that might knock out the stoutest mosquito.

I do not know if the Lycaenid I've got is *phasma*, for I have kept no type. [It is *phasma*.] Anyhow it is just as well, for it gives me no bias. The egg is most cunningly placed inside the small flower on the lower lip of the corolla. For a Lycaenid egg it is quite large and of a pale blue colour. I have just looked at the first set of inflorescences on which the specimen caught on the 5th (it was Bank Holiday) oviposited. I only found two ova and those with difficulty, for the swollen nectaries, which secrete at a great rate even when the flower is cut, are rather like the ova, and I think I must have overlooked some, for I now find there are about half a dozen unmistakably Lycaenid larvae, tiny little things and rather bristly, one of a yellowish colour, the others red-purple like the flowers. I wonder if I'll be able to do anything with them before I have to sail. Of course they may not be *phasma*, but I think, if the Lycaenid completed its whole existence on the plant, that Lamborn would have found them. Plants are difficult to dry at this time of the year, but I'll send a specimen in spirit for you to send to Kew. I am also to send the *Loranthus*. [Both sent on the following day, Aug. 12.]

[Dr. O. Stapf of Kew informs me that *Solenostemon ocymoides* ranges from Senegal to the Congo. It is very closely allied to *Coleus*, the recognised food-plant of *Precis*, so it is not surprising that Mr. W. A. Lamborn should have found the larvae of *P. octavia* upon it (p. 399).]

It is in a way rather unlucky that I should have to go home, but it will be about a month before the next boat goes, and I may have some luck in the interval. Anyhow, if the wretched Boche doesn't get me it will be a nice problem to come back to, and if the aforesaid Boche does get me, perhaps Lamborn will supply the missing link. I think the fact of the oviposition being *on the flowers* is significant. *Camponotus maculatus* is a notorious nuisance in sugar cases. They are always crawling about flowers, and I think it likely that the food of the *phasma* larvae in the *Camponotus* nest must be regurgitated nectar. Of course they might turn carnivorous at the next stage, but I've little doubt that, given a chance, I ought to be able to clear it all up. It is only a matter of time.

Aug. 25, 1918.—I told you about finding the Lycaenid (possibly *Catochrysops*) ovipositing on a Labiate plant. I now have a lot of young larvae, but they will not be mature before I sail. However, I am to ask Dr. Connal to follow up their life-history, if it can be followed. In trying to find fresh food for the larvae I have had difficulty in finding plants *without* tiny larvae already feeding on them, and the butterfly, whatever it is, is busy all over some of our more weedy plots. I have of course but a somewhat dim recollection of *phasma*, and more than probably I am on another butterfly altogether, for two larvae have pupated! So far I have only seen one type of butterfly (those sent to you) ovipositing, but somehow the pupae seem to be too small for that type. I have been able to provide abundant "chop" for the larvae, and the pupae cannot be small on that account. But the larvae are very variable in colour. If the inflorescence on which they feed is rather young and predominantly green, the larvae are green and red. If the inflorescence is predominantly reddish-purple, with mature, fully opened flowers, the larvae are reddish-pink, and when very young, extremely difficult to pick out among the tiny hairy flower-stalks which they closely resemble. Those that pupated were mostly green, with hints of red round the margin, but they "went up" on a green leaf. The pupae are distinctly bristly too. I wish I could have stayed another month, but it is no use trying to get it. They'd think I was funking the sea, which I do in a way, but not enough to reduce me to make them think I felt like that. However, it is quite likely that the plant grows in East Africa and maybe *phasma* is there too, or whatever form I've got, and Lamborn will know the host-plant of *Precis octavia*. He will be able to clear it up if I never get another chance.

Lagos.

Aug. 31, 1918.—I sail to-morrow morning. Two days ago, or rather a day or two before that, I had decided that I had two sets of larvae on the Labiate, one green or reddish or both together, of which four pupated. Two of these have emerged, and they are a small and very pretty form. The other set are reddish *only* right through, but have grown very slowly. They are by far the most common. In fact, every plant one picks carries a few. None have pupated, and I begin to think they won't. Some have died of a fungus disease (in one only of my tins), but one of the other type also died.

I sail to-morrow morning, but I am to see Dr. Connal this afternoon and he will be able to tell you the sequel. It is very bad luck that I should have to go just now, but it can't be helped. I feel sure that they are *phasma*. I actually found a *maculatus* which had got caught by a spider on one of the host-plants, but it was dead. The worst of it is that the *Camponotus* is a "night hawk," and one seldom sees them at all in the day.

Now I must close. I do hope I'll get the chance to complete the life-history myself on my return.

Yours sincerely,
C. O. Farquharson.

[These were the last words I received from my friend. There can be no doubt that the larger larvae were *C. phasma* and that they are carried by the ant to its nest to complete their development. The imagos of the smaller Lycaenid, which lives throughout larval life on the food-plant, were probably taken on the "Burutu" and lost. I have tried but failed to receive any communication from Dr. Connal concerning the material left with him by Mr. Farquharson. It is probable that the smaller Lycaenid larvae possess the power of individual adjustment to the changing colours of their food-plant, in this respect resembling those of *Lycaenesthes lunulata* (p. 386).]

III. MISCELLANEOUS OBSERVATIONS ON RHOPALOCERA.

A. NOTES ON BREEDING CERTAIN NYMPHALINAE.

1. *Charaxes etheocles* Cr.—[An account of the series of specimens, with male-like females, bred by C. O. Farquharson and W. A. Lamborn, has been published in Proc. Ent. Soc., 1918, p. lxxxiii.]

Oct. 16, 1915.—The larvae were obtained from the same plot of *Adenanthera pavonina* at Moor Plantation. I have rarely seen more than one or two at a time.

July 26, 1915.—I have five *Charaxes* pupae just now, but this will be the last for a time, for the young trees on which they feed are being transplanted. These trees also one day were raided by drivers. The place is simply alive with them just now owing to the dull weather.

2. *Charaxes varanes vologeses* Mab.—[The bred specimens referred to below are a male, emerging June 22, 1917, and a female which pupated June 12.]

Oct. 18, 1917.—I had rather a bit of bad luck over them, for I chased the mother all over a ten-acre field of ground-beans between the burning hours of 11 and 12 noon, only to lose her. I raised three from the eggs I saw her lay before I got home for my net. However, I may have better luck next time.

3. *Palla violinitens* Crowley.—[The following note, written from Kew, almost certainly refers to a female of this species labelled with Farquharson's initials, but no other data. Its position in the Moor Plantation collection proves that it was bred or collected in 1913 or 1914.]

Oct. 20, 1914.—I bred out a very nice *Charaxes* before leaving, or rather it was a pupa when I left and a friend sent it on. I do not know the name of the host-plant, which had at the time neither flower nor fruit, but may know it again. The larva had purple blotches on the skin.

4. *Euphaedra ravola* Hew.—[Of the bred specimens referred to, 1 ♂ emerged Aug. 22, 1915; 1 ♂ 5 ♀—7.0 a.m. Aug. 23; 1 ♀—Aug. 24. All have precise pupa-cases. Six families of this species were bred by W. A. Lamborn at Oni and the resemblances between their larvae and those of several other Nymphalines recorded in Proc. Ent. Soc., 1912, p. cxix.]

Sept. 28, 1915.—The Euphaedras were found as larvae in a company on their host-plant. They were a curious chocolate-brown colour with processes like those of *Hamanumida* or *Aterica* of a vivid sulphur-yellow colour, which gave them rather a fearsome look.

5. *Harma* (*Cymothoe*) *theobene* Dbl.-Hew.—[The material, bred in 1915, includes 3 ♂ emerging Aug. 1, 9, 11; 2 *nigrolutescens* ♀ forms (p. 469)—Aug. 4, 21; 2 *theobene* ♀ forms—Aug. 10, 11. The ♂ and ♀ of Aug. 1 and 4 pupated July 22 and 26, respectively. All except the ♀ of Aug. 21 have precise pupa-cases. For an account of the ♀ polymorphism of this species and Lamborn's families from known female parents see pp. 469–72.]

Sept. 28, 1915.—I am most interested in what I think must be a *Cymothoe*. The caterpillars were all found on the same host-plant in the bush, and were all identical. There would appear to be three imaginal forms.

6. *Neptis nemetes* Hew.—[Two specimens with precise pupa-cases were sent, bred from larvae found on the same plant in the bush:—1 ♀, emerging 1.0 p.m., Aug. 11, 1915; 1 ♂—Aug. 12. The ♀ pupated Aug. 1.]

7. *Acraea lycoa* Godt. and *A. pentapolis* Ward.—[A bred series of *lycoa*, 2 ♂ 4 ♀, emerging Aug. 22, 1915; 2 ♂—Aug. 24 and 25, these two latter with precise pupa-cases. One ♀ *pentapolis*, emerging Oct. 2, 1917, from a pupa found at Agege.]

B. The Under Surface of the Nymphaline Butterfly Crenis amulia Cr.

[The following letter was written from Kew. Two specimens are labelled "Aro-Chuku 13.v.14," the third, undated, "E. Prov. of S. Nigeria. Bonny, Aba, Aro-Chuku, Azumini. Butterfly showing *Hamanumida*-like variation." The resemblance to a common form of the variable under-surface of *Hamanumida daedalus* F. is certainly strong, and it is probable that Farquharson was suggesting mimicry of the abundant by the rarer species. It must, however, be remembered that *daedalus* could only act as a model during the daylight hours of complete rest. In the intervals of the active state it invariably rests with expanded wings, as Farquharson well knew (Proc. Ent. Soc., 1914, p. xxxix).]

Oct. 26, 1914.—I am sending three butterflies—not in good condition, I regret to say, and to be effective I ought to have had more. They seemed to me as I watched them in passing through the districts where I saw them, to show under-surface variation recalling that of *Hamanumida daedalus* very markedly. Perhaps this feature of this particular species is well known to you, but I am not sure whether I have heard Dr. Lamborn mention them.

C. The Migration of Libythea labdaca Westw., at Moor Plantation.

[For further observations on the migration of this butterfly in W. Africa see Proc. Ent. Soc. Lond., 1916, p. iv; for that of *L. laius* Trim., in B.E. Africa, *ibid.*, 1912, p. xcvii; 1921, Swynnerton, p. lxii; and of *L. bachmanni* Kirtland, in Texas, Ent. News, Oct., 1917, and E.M.M., 1918, p. 16. I wrote to Farquharson about the inconsistency in the direction of flight in his letter of May 3, 1917, but this was one of the subjects he had left to discuss during his leave. Fortunately, however, his letter to Dr. Hill leaves no doubt about the interpretation.]

March 20, 1915.—It has been dry since I came out till within a few days ago.

To-day the migration of the Libytheas has been in progress for more than two hours now. A constant stream of them has been flying across the station in a S.S. Westerly direction. I have now seen this migration three times, and each time it has been in the same direction. I am not sure if the seasons have corresponded, but I rather think that is so. The particular species is not very common here ordinarily, if anything they are uncommon. I have only seen them a common species in one place, at Aro-Chuku in the Cross River district, near Itu, which is N. from Calabar.

May 3, 1917.—The northward [southward] flight of the Libytheines took place yesterday and the day before. In some places the natives take the appearance of the migrants as a sign that the planting season for such crops as maize and other annuals has begun, which is equivalent to saying that the rains have definitely set in. They go southwards [northward] again at the end of the season. This year the flight is late, for I recall that when I laid down the ground-nut experiment which led to the discovery of the Mylabrids, about mid-April, the flight was then in progress.

It is curious that these inconspicuous almost cryptic forms have the queer habit of settling in great numbers on white-washed culverts, white stones and such things, where they are most prominent. [See Swynnerton in Proc. Ent. Soc., 1921, p. lxiii, for evidence that *Libythea* seeks some chemical substance.]

[Mr. Lamborn agrees with me that there can be no doubt that "southward" and "northward" were accidentally transposed in the above letter. As the passage stands it is inconsistent with the letter of March 20, 1915, and also with the following, written by Farquharson Aug. 23, 1918, to Dr. A. W. Hill, F.R.S., and published in Roy. Bot. Gard. Kew, Bull. No. 10, 1918, pp. 355, 356.]

"Early in the rains for two or three days thousands of migrating Libytheine butterflies pass here flying southwards. The negro peasant knows that after that he may safely sow his cereal crops—maize, at any rate. Towards the end of the rains swarms of the same butterflies return northwards. One may conclude that the rains are over. Between the flights to and from the forest belt we never see them."

D. A LYCAENID FALSE-HEAD-LIKE APPEARANCE PRODUCED BY TWO PIERINES IN COITÛ.

[The attitude described was roughly illustrated in the following letter, but it is somewhat difficult to understand. In order that the antennae of the butterfly enclosed between the wings of the other should alone be visible it is necessary to assume that the abdomens are sharply bent into an S.]

Aug. 11, 1918.—I read with special interest that theory about the false "head" of Lycaenid butterflies. I hope you will not imagine that I was wise after the event, but the theory brought to my mind a curious error into which I fell a day or two earlier. On a plant in my garden I saw what I thought was rather a large white Lycaenid that I'd never seen before. With the exception of things like *Catochrysops*, few Lycaenids come up to the clearings round our quarters, most of them preferring the bush near the river. I was quite surprised at such a fine large one with rather long tails. Having no net I put out my hand to grasp it, but "it" flew away. "It" was really two moderate-sized Pierines *in coitû*, which had settled down on the plant. I wish I could draw their position, but you will perhaps realise how things were from my rough sketch, [showing the] antennae of the second one [projecting behind like tails], the wings being quite invisible, enclosed by the wings of the first. When they took to flight the illusion was, of course, obvious, but when they were at rest, and I was not looking for anything in particular, I was completely taken in. I was so surprised that I hardly noticed which of the Pierines it was, but I shall more than probably see the same thing again. The memory of the incident, however, made me read the false-head theory with great respect.

E. A REMARKABLE LARVA, PROBABLY PAPILIONINE.

Mar. 2, 1918.—One evening about a fortnight ago I was looking at the small fruits of a tree growing by the river side which I had been told were edible. The tree is, I believe, a Sapotaceous one, of the genus *Pachystela.* I noticed a very subtly cryptic larva, of a dry earth-brown colour, resembling a dried-up catkin more than anything else. Its attitude, with head and front thoracic region lifted, so that the larva stood on its pro-legs, made it rather moth-like, especially as it had rather a long gap between the last pro-legs and the clasper hind "feet," and this posterior region was also held up. I took it in and it fed readily. Its frass was rather characteristic, consisting of fairly large pellets, hollowed out so that when dry they looked like small air-gun lead caps or pellets. At the next moult the larva was more remarkably coloured. It had clubbed spiny processes on it even when first I saw it, and these became more pronounced, but the colour changed to a wonderful mottling of green and brown with little hints of red. You may be sure I was glad to see it pupate to a swallow-tail type of pupa, but the next day the pale green pupa turned black and shrunk and is, I think, parasitised. What is worse, I cannot find any more, but the tree is fairly common and I may, unless its season is just over.

F. THE HESPERID RHOPALOCAMPTA FORESTAN CR., PROBABLY ABSORBING SALT.

[The following note, additional to those published in Proc. Ent. Soc., Lond., 1916, p. lxxx; 1917, p. lxxviii, is quoted from one of Farquharson's letters.]

Government Farm, Agege.

Dec. 15, 1916.—I have since seen *Rhopalocampta* doing the same on the cement floor of the office verandah. I didn't notice any spots [of perspiration] at the time. The chair, on the arm of which I saw the butterfly [Proc. Ent. Soc. Lond., 1916, p. lxxxi] was an old one. It is possible that the surface, from one's habit of involuntarily perspiring in this country, might be rather saline, but I'll try to get further observations. My first one was lucky, for the action was so prolonged. I had no difficulty whatever in seeing what was taking place.

IV. MISCELLANEOUS OBSERVATIONS ON HETEROCERA.

1. *Elaeodes brevicornis Walk.: Noctuidae, Acronyctinae* (*Diphtherinae*).—[The material of the following note includes 2 ♀, emerging about 5.0 p.m. and after 6.0, Mar. 18, 1917; 3 ♂ 2 ♀ (with cocoons)—Mar. 19; 2 ♂ 1 ♀—Mar. 20. The next species *E. acatharta* Hmpsn., in the British Museum collection, is accompanied by pupa-cases and preserved larvae. The larvae appear to be even more conspicuous than those of *brevicornis*, but the pupae less so. The cocoons of both species are very slight so that the pupae are visible.]

Mar. 18, 1917.—Two of the fern-feeding moths have emerged to-day, one about 5 p.m., the other after six. I can't say the exact time as I was out when the second came. It is rather a pretty moth. The larva was about an inch and a half long, of somewhat " loud " pattern, being striped dark brown, almost black, and yellowish white, with translucent brown, ventral surface. In spite of their rather formidable appearance they were rather timid, and dropped to the ground when disturbed. The body had very sparse hairs. I took a dozen larvae—as many as I could reach—all of which pupated in the next two days. They bound one or two of the fern pinnae together with silk threads, but not by any means elaborately. The pupa itself is rather a bizarre, brown-and-yellow-coloured object. I collected them because it struck me I had not seen many larvae—Lepidopterous at any rate—feeding on vascular Cryptogams, but it may be quite common.

2. *Eublemma scitula Ramb.: Noctuidae, Erastriinae.*—

[Two examples bred May 14, 1917, from larvae feeding on *Aleurodes africanus* Newst. (p. 528) on the under surface of leaves of *Salacia* sp. (*Celastraceae*), in Farquharson's compound. The plant, which Farquharson thought to be *Anona muricata* L., was determined by Mr. T. A. Sprague of Kew.]

3. *Selepa leucogonia Hmpsn.: Noctuidae, Sarrothripinae.*—Two examples, one bred Nov. 1, 1917, the other probably in the same month, from larvae feeding on Wine Palm Scale.

4. *Bareia incedens Walk.: Noctuinae.*—One moth "bred from fairly large, pale green larva, found Feb. 21, 1917 (spun Feb. 22), on leaves of Lycaenid tree," *Alstonia congensis.*

5. *Two remarkable Larvae, Geometrid* (*Hemitheinae*) *and Notodontid* (*Stauropus*).—[Both were received in alcohol. The extraordinary Geometrid larva is described and figured by Dr. Eltringham (p. 487). The Notodont larva is evidently allied to our *Stauropus fagi* L., and the mimetic resemblance is of the same kind, although carried further in that the posterior part of the larva, being coloured green, represents the prey and the anterior part, the ant attacking it. The remark of the "boy" supplies interesting confirmation. In the later stages of *fagi* Portschinski suggests that the caudal shield represents a Pentatomid bug, and the rest of the caterpillar its victim ("Coloration marquante et Taches ocellées," V.: St. Petersburg, 1897, pp. 44 et seqq.). For the ant-like appearance of the young *fagi* see Linn. Soc. Journ. Zool., vol. xxvi, 1898, pp. 589, 590, pl. 40, fig. 1. In Farquharson's specimen the head, true legs and anterior segments are black, like an ant, while the green colour begins abruptly with the 3rd abdominal and is continued backwards to the caudal shield, which, of a brownish tint, doubtless represents the head of the victim. The two long slender caudal filaments lie along the ventral surface of the shield. The 1st and 2nd abdominal segments bear a pair of long, sharp, backwardly curved processes, one on each side of the mid-dorsal line. They are beset with short, sharp spines.]

Agege.

Oct. 18, 1917.—Yesterday was a day of surprises. I found a looper larva that looked exactly like a small centipede, that is, it was dorso-ventrally flattened and had extraordinary processes along its sides, or rather developments of the segments. It was not on its food-plant, and I think I will have to kill it without knowing what it is. Finally, my boy brought me a curiosity. It looked like an ant (a black one about the size of a *Camponotus* (*Orthonotomyrmex*) *sericeus* F.) in the act of engulfing, in a thoroughly un-ant-like way, a green caterpillar. "What on earth is this, Joe?" I asked. Said he, "I think some ant ketch 'um." Then I found it was all one animal. I remembered a picture in Shelford [lowest fig. on pl. xvi, facing p. 230 of "A Naturalist in Borneo"], and to-day I found in Lefroy's "Indian Insect Life," p. 472, a picture of a Notodontid larva [*Stauropus alternus*] which, I think, must be of the same genus. Looked at closely, of course, it isn't a bit like an ant, but more than likely it is the first impression that is the saving impression. The enemy in nature is not going round with a Zeiss pocket lens magnifying so many diameters.

6. *Ereunetia fulgida Warr.: Geometridae, Boarmiinae.*—[Mr. L. B. Prout considers that Warren's *flava* and *curvifera* are synonyms and his own *orientalis* a geographical race of *fulgida*. A single male was captured, attracted to a lamp, July 12, 1918. Farquharson noted that, in the resting position, the wings are held upright over the back, as in many Geometers. Farquharson was here doubtless referring to the brief rests between the flights —not to the position assumed in prolonged rest. This moth is an interesting addition to the great group mimetic of Lycid beetles (Trans. Ent. Soc., 1902, pp. 515–18; Proc., 1918, pp. cxxxviii–cxlii.)]

7. *Parasa viridissima Holl.: Limacodidae.*—[Two moths bred Dec. 19 and 20, 1917, from larvae feeding on Coconut Palm at Awka, 22 miles E. of Onitsha.]

8. *Margaronia prasinophila Hmpsn.: Pyralidae, Pyraustinae.*—[The following note by Farquharson, together with the ♂ Pyrale (both numbered 477), was sent to me by W. A. Lamborn.]

Feb. 4, 1914.—On entering my house the other day, Jan. 29, 1914, I observed a pale green Pyralid moth on the wall of my room. This was about mid-day, and the moth was in a position of rest. On my approaching for a nearer view the moth moved slightly, evidently in alarm, though without attempting to take to flight. At the same time, too, from its posterior end a tuft of dark hairs was exserted, and the tip of the abdomen rotated rhythmically from side to side, the hairs remaining extruded all the while.

I captured the moth by putting a glass over it, and put it on a side table where I could observe it more conveniently. During this operation the moth was of course violently agitated and fluttered about inside the glass, ultimately, however, settling down. From a position which I judged to be invisible to the moth I observed that the rotation of the abdomen with its extruded tufts continued for some time before the normal position of quiet rest was assumed.

By disturbing the moth inside the confined space of the glass, I tried to discover whether any odour was emitted, but unsuccessfully. I do not, however, lay stress on this, as my olfactory sense may have been at fault.

9. *Mnemoses farquharsoni Durrant, gen. et sp. n.* (p. 494): *Tineina, Hyponomeutidae.*—[Material:—Fifteen moths, with precise pupa-cases, 2 bred Oct. 2, 1917; 12 (3 in British Museum)—Sept. 23–Oct. 11, 1917; 1—Jan. 17, 1918, from larvae in silk web as described below. Also 3 webs, and examples of larvae in spirit. From the bark of Pará Rubber, *Hevea brasiliensis* Müll. Arg. (Euphorbiaceae), at Agege. None of the parasites mentioned were received.]

Agege.

Sept. 27, 1917.—I have also sent two little moths labelled Pará Bark Moth of which I will write you later. I regret to say I took the larvae for Coleopterous specimens, but they spin a protecting web like Embiids except that they dust it over with fine sawdust. They live on the outer cortex and are quite harmless, only all Pará trees crawl with *Oecophylla*—or bristle with them I think would be a better term—which are constantly running up and down, over the "webs," so that, in a way, this little moth gets over *Oecophylla.*

Agege.

Oct. 18, 1917.—I also sent some more specimens of the Pará Rubber bark-feeding moth. I hope some of them will get home with sufficient scales on them for diagnosis. I tried folding back the wings and failed utterly. The other way could hardly be more ruinous, but I will have a further try. I fear I suffered from nerves. With the specimens I sent a piece of the extraordinary web they weave. For such tiny moths, their achievements in this way are rather remarkable. The Pará tree from which that substantial piece came was covered nearly all round for 3 or 4 feet of its length, from about 5 feet from the ground upwards, and the circumference of the stem would not be less than 25 or 30 inches. For the most part the web is of single texture, but the larvae appear to pupate gregariously, and over the place selected for pupation the web is several layers thick and each pupa is immediately surrounded by a very tough piece of the fabric. I have bred out quite a number and found no parasites. I may say, too, that Pará trees here are almost without exception infested with *Oecophylla*, and I am sure give rise to much " bad " Yoruba among the tappers. *Oecophylla* is a most unreasonable animal, hardly ever waiting to be attacked. Unconsciously I should think they do much to protect these little moths, for they run freely over the protecting fabric and few other things share their hunting-grounds. How the little moth gets out is a question I cannot answer. The first larvae I found were under rather an old dilapidated fabric, and I thought they were some sort of Coleopterous type. I ought perhaps to add that there are normally on Pará trees brown patches of bark, free from lichen, which are difficult to tell at a distance from the web of these moths—really difficult to tell.

Moor Plantation.

Jan. 8, 1918.—During the week-end I was at Agege. I had to go down and pay the men, besides checking two months' rubber yield, so that, as I only got down on Saturday—6 hours in the train—and back here yesterday, I had to work most of Sunday. I managed, however, to secure some excellent specimens of the Pará moth web, which I will send next mail. I can't get time—indeed, haven't quite enough material—to send this mail. I also got cocoons of a Hymenopterous parasite, but so many are hyperparasitised that I doubt if I'll get a specimen of the original. I saw quite a dozen tiny Chalcids or Braconids on the surface of one web. I also found a few Dipterous puparia, but practically all parasitised. It is the larva that is attacked.

May 28, 1918.—While at Agege I had a hunt for the little Pará moth parasites. They are a Dipteron of some kind and an Ichneumon, but I couldn't find one that hadn't been parasitised in turn by a tiny Chalcid or Braconid. The latter I frequently found inside the " web." I am in hopes that I may yet get the original parasites, for the moth is very plentiful at present.

B. MISCELLANEOUS OBSERVATIONS ON INSECTS.

I. APTERA: COLLEMBOLA.

May 3, 1917.—P.S. again. If Lamborn is at Oxford I wonder if you'd ask him whether he ever did anything with curious very tiny blue-black wingless insects that appear at this season after the early rains. They are gregarious and occur in vast numbers, so that they look like a mass of bluish "soot" on the ground, or like a great splash of ink. They pass over the ground in a wave, sometimes many yards long. I have never seen what I consider would be the mature forms, but I must send you some. When you disturb the mass they rise and scatter, like a film of smoke—of course, only rising for an inch or two above the ground.

[Specimens collected by Mr. Lamborn at Moor Plantation (May 17, 1914) have been determined by Prof. G. H. Carpenter as *Isotomina 12-oculata* Carp., the species from Nyasaland referred to below. Prof. Carpenter has kindly written :—]

"*April* 27, 1921.—I think that you should certainly publish the note, as we have so little information about the bionomics of tropical Collembola. This habit of crowding together is, of course, well known with respect to many British and European species—such as *Podura aquatica* on the surface of ponds, *Anurida maritima* on tidal rock pools, and *Achorutes socialis* on Alpine snows. The species of *Isotomina* from Nyasaland, described in Sci. Proc. R. Dubl. Soc., vol. xv (N.S.), No. 39, p. 543, must be a markedly social insect, as there were hundreds of specimens in the collection, and the same may be said of the antarctic *Gomphiocephalus hodgsoni*, which the naturalists of the second Scott expedition found in swarms on frozen pools and among snow in S. Victoria Land. (My paper on this is now in the press among the 'Terra Nova' reports.)"

II. NEUROPTERA.

A. EMBIIDAE.

Notes on Embia (Rhagadochir) apicata Silvestri, sp. n. (p. 449), *and a larval Embia on Cotton-seed Sacks.*

Material:—Two ♂, 2 ♀ from webs on the Pará Rubber trees at Agege; the ♂♂ bred at Moor Plantation and referred to as sent off in a letter of March 23, 1918, the ♀♀ sent from Agege, Oct. 1917. Webs of the same species from Agege, sent Feb. 8, 1918. Also 4 larval Embiids from webs on cotton-seed sacks at Moor Plantation and web-covered sacking from the same store, referred to in a letter of Aug. 12, 1918. Farquharson considered that these latter were distinct from the Agege species, but Prof. Silvestri thinks that they are probably the same (p. 450).]

Government Farm, Agege.

Dec. 15, 1916.—There are one or two species of Embiids about here. They are extraordinary. Their " reversible " gear must be most efficient, for they can run backwards or forwards equally easily and rapidly.

Agege.

Oct. 18, 1917.—I thought at the same time [as the observations on the moth larvae, p. 410] it might be worth while to note any other insects that share the Pará Rubber trees with *Oecophylla*. One variety I have long noticed and always intended to send. I hope to send some soon. These are Embiids. There are several trees here that are covered round and round their stems up to the forks (about 10 to 12 feet) with a glistening felt of silk, which gives them in a half light a curiously ghostly appearance. On closer inspection the web is seen to cover an extraordinary network of " tunnels " of much denser opaque fabric, but the insects do not confine their journeyings to these thicker-walled tunnels, but can easily be seen under the general covering web. I once saw a winged one, but lost it, and have never seen another; but I recollect still that the wings were of a blue-black colour and somewhat lustrous like those of some wasps. I am in hopes that I may get winged forms again, for the species, whatever it is, is quite common on the Rubber trees—*Oecophylla* notwithstanding. They are really most extraordinary creatures with a perfectly amazing faculty of running backwards or forwards at will. They prefer the normal way, however, and turn themselves with astonishing ease in little space. When they run forward the hind legs appear to be more or less passive. On such a tree as I have described there must be enormous numbers. I am not exaggerating. The silk has a peculiar, sort of moonstone lustre, or might be compared to a vast snail-smear though composed of threads, and the "vanishing tree" effect is really quite striking.

Moor Plantation.

Dec. 12, 1917.—I have also sent one or two Embiids.

Jan. 26, 1918.—The Embiids feed on the dead cortex—possibly for the lichen—of Pará Rubber trees. I have a few with wings developing.

Feb. 8, 1918.—I send a box with Embiid silk. It is difficult to get a good specimen—it is so fine. You will see the frass in the silk, but the frass seems to be concentrated at certain centres where the silk is several layers thick, not unlike the thickened part of the little moth "mat." At these padded parts, too, the young seem to congregate. I will write a full description of some of the curious habits of the Embiids.

Feb. 14, 1918.—I hope to get some interesting things about the Embiids. I believe they show the beginnings of social life—more than the beginnings, in fact. The Embiids feed on the dead cortex of the rubber tree. There is no doubt about that either. And there must be hundreds on a single tree, all under a common silk covering. I don't exaggerate when I say that I have seen 10 or 15 feet of the bole of a rubber tree, not less than 30 to 35 inches in girth, covered round and round with the silk. *Oecophylla* can walk over it but cannot get into it. Under the general web are thickened, practically opaque silk tunnels that converge at large "junctions" where even the general web is several thicknesses. Under these thickened portions the insects, especially the young ones, seem to collect. The whole thing looks like a map of the tube railways, the lines being of thick opaque silk and the whole overlaid with a thin but impenetrable (to other insects) film of semi-transparent silk. The "lines" are not, I think, tubes but simply portions thickened for more effective concealment, perhaps in the daytime. There are lots of points to clear up, but every time I go to Ágege I'll get a little more study put in.

March 2, 1918.—My Embiids haven't got their wings fully developed yet, so they are not sent. I hope they will get home all right.

March 23, 1918.—I have nothing to send this mail, for I have been very busy, but I've got a winged Embiid, the wings blue-black and slightly lustrous as I remembered seeing once a long time ago.

July 19, 1918.—I have found a most populous and prosperous species that lives in bags of cotton-seed, the tunnels and greater part of the web being on the outside. It will be as easy as possible to send you really great specimens. A British Cotton Growing Association's store near by, which is full of bags of cotton-seed, simply swarms with the insects. I haven't yet found out what they eat. I am to try to bring you home a live family. If I can get safely to a British port I will immediately post them to you, and perhaps if they were put in an incubator at about 80° they might live long enough for some one to study them fully. It is a different species from the Pará one, but the silk tunnels are exactly the same. I haven't seen any winged forms.

Aug. 12, 1918.—The other box contains a piece of sacking with typical Embiid silk galleries. There is also a small tube, with four of the Embiids. The species is much smaller than the Pará Rubber one. I hope to bring home some of them alive. So far no winged forms have appeared. I am not yet certain as to the nature of their food. Their galleries permeate the cotton-seed. I hope the specimen will not get rubbed more than can be helped. The specimen will give you an idea of what a Pará tree looks like when its bole for ten or fifteen feet up (and even well up the higher branches) is covered round and round with such a web. The Pará one's web is scarcely so dense, being as it were translucent, which gives the trees the "ghostly" appearance which I have already described. I do not think that I exaggerate when I say that there must be hundreds in a colony. In the cotton store hundreds of bags had splashes of white on them, and altogether there must have been thousands of the insects. The store had unfortunately to be emptied (the seed being distributed), but I've little doubt but that they will appear again next season. The (Agege) Pará form I think certainly feeds on the dead outermost layer of the cortex. The frass is quite solid, in the form of round particles. The frass of the cotton species is very similar. I think there can be no doubt that the galleries are protective. As I told you, *Oecophylla* constantly run over the silk of the Pará form, making no attempt to penetrate it. They readily attack and kill individuals that one forces outside the web.

B. TERMITIDAE.

1. *Three Genera of Termites from a small part of a single Carton Nest at Agege.*

[Material:—A tube containing Termite soldiers and workers in spirit, from a "fresh bit of carton nest not as large as a football"—the nest (formed in a stump), in the disused parts of which *Camponotus maculatus* had established itself, and *Catochrysops phasma* pupae were found at Agege, on Sept. 10, 1917 (p. 392). Mr. Hugh Scott kindly examined the specimens and recognised the existence of three species among the soldiers. He then submitted the material to Prof. F. Silvestri who determined the species as *Ancistrotermes crucifer* Sjöstedt; *Hamitermes evuncifer* Silvestri; *Pericapritermes urgens* Silvestri, var. *nigeriana* Silvestri. Workers as well as soldiers of each species were present. Prof. Silvestri wrote March 22, 1920: "It is possible that all the specimens were found under a decayed trunk or in an earth nest of Termites, but I can assure you that each species has its own galleries. We do not as yet know any species of Termite living in the same gallery with another species, but it is very common for two or more species to be found in the same nest, as described in my paper on West African Termites." ("Contribuzione alla conoscenza dei Termitidi dell' Africa occidentale," Boll. lab. zool. Portici, ix (1914), pp. 20, 73, 135.)]

Sept. 18, 1917.—I am curious to know what the Termite is that figures in my *Camponotus maculatus* Lycaenid find (p. 392). They are of no direct connection, but you will see when I send you a few that I put in spirit, that the "soldiers" [of *Pericapritermes*] are extraordinary looking individuals with particularly extraordinary mandibles exhibiting marked asymmetry. I have been puzzling over the value of such an odd departure but have had to give it up. They had a curious habit too of jumping in a manner recalling some *Ponerinae.* Their jump only carried them half an inch to an inch away, but it was most characteristic and was not a feature of the workers. These latter too have normal symmetrical jaws. I could not detect any intermediate forms and the soldiers were curiously few in number and isolated. [Believing that only one species was present Farquharson assumed that the soldiers of the other two were workers.] Though I can send you no sexual forms, perhaps the species is well and easily recognised by its odd soldiers.

The species of Termite is one that fastens on to large bush stumps and gradually converts them into a carton and mud heap, mainly carton, unlike *T. bellicosus* our commonest form whose hill is entirely of clay.

2. *A Swarm of winged Termes bellicosus Smeathm.*

Sept. 18, 1917.—Termites are the same [as *Camponotus maculatus*, in the sexual forms being phototropic, the others lucifugous: pp. 424–25]. The flying stage of *T. bellicosus*, which I believe is our commonest one (it is preyed on by *Megaponera*), is a bigger nuisance than all others and is all the worse from being more frequent. Not long ago a swarm of these invaded my place. They soon drop their wings, and in that de-alate condition are much relished as an article of food (cooked) by the Yorubas. I find a hurricane lamp placed in a basin of water a useful trap. After dinner I went out to see the "catch," and found the night watchman (this was at Ibadan) eagerly sweeping up hundreds of them that had alighted round his lamp. He plunged handfuls of them into a bucket of water to keep them from wandering off, and appeared thoroughly well pleased over this manifestation of the bounty of Providence. A little native cat of mine was also very busy eating those that escaped the watchman. I watched "William," the cat, with amusement at first and then with closer interest as he started hopping round in evident trouble, something obviously having bitten him. A serious-looking and somewhat inflated frog (he also happily gorged) was also moving out of the way. I went down the verandah stairs to investigate, and found that the Termite winged forms were coming from numerous innocent-looking small holes in my quite level compound. There was no hill, and their presence there was a great surprise to me. But the source of "William's" trouble and of the frog's caution was soon evident. The watchman also suddenly became acutely conscious of it. The surface of the ground was swarming with soldier Termites, and a *bellicosus* soldier gives a rather severe bite. After a time the swarming ended and the soldiers disappeared underground again.

C. PSOCIDAE.

Psocus nigeriensis Newst., sp. n. (p. 452) *and two other species on "Ant-trees" at Agege.*

[Material :—Eight *P. nigeriensis*, labelled "Common on Pará-tree bark (gregarious), Pará Rubber plantation, Agege, Sept. 22, 1917."]

Agege.

Oct. 18, 1917.—During September there were to be seen on the Pará trees colonies of curious little creatures that appear to me to be related to *Psyllidae* or some nearly related group. At first they are wingless and sit and feed crowded together in a circular mass about the size of a crown piece or even larger, apparently in defiance of *Oecophylla*. They retain the gregarious habit till they become winged, after which I think they must separate. The imago after the last change is at first whitish in colour. In the mass they are by no means conspicuous. Just to-day I came across yet another curious colony, very like young Psyllids but protected by a thin silky web. I hope to get a few mature forms with good luck. Under the web are enormous numbers of eggs, of oval shape. I sent you one or two of the first group and will send more later.

Moor Plantation.

Feb. 4, 1918.—I am sorry that they were in such bad condition, for they are the most dreadful beasts to put up that I've yet tried. That was why I put some in spirit—immature forms—though I had another reason too, of which I'll tell you. I wished to let you see that they *had* abdomens, for they shrink terribly in drying. When alive they are miserably soft and delicate creatures, the slightest pressure causing them to burst. They are likewise very difficult to catch, not because they take alarm and fly: they don't, but they refuse to leave the bark of the tree. The net cannot be used, and when one puts a tube over them they simply sit still or at least won't go up the tube. I may say that I know of three species! All so far I have found on "ant-trees," but I've had two horrible misfortunes in losing two sets of the others, but it is only a matter of time before I get them again. My chief reason for sending the spirit ones was because I saw no evidence of the adults feeding, while the immature forms appear to *eat* bark! I intended to look for a biting apparatus, but had to send home the material before I got time; but what I took to be their frass appeared to be solid. Let me say definitely that the ants do *not* attend them, they ignore them, though why they should tolerate such soft-bodied, harmless things I don't know. The Pará species is left alone by *Oecophylla*. The other two species were on *Cremastogaster* trees, *Antiaris* and an Anonaceous tree, the latter a beautiful form with almost black wings. It seems almost incredible that such large insects could have been overlooked. They feed in a colony and remain together till the last, when they disappear. Males I think are very rare, if the males are one or two relatively tiny forms that I've seen amongst the crowd of large ones. I am sure they are not sucking insects. I should say a colony might number a hundred or two. They generally congregate in a circular crowd. I think I know their eggs, which are like little rafts of mosquito eggs, very similar indeed, but I was waiting a chance to see them emerge before making any announcement. I am looking forward to hearing more of them. I'll try sending the next I get in wool like mosquitoes. I am in hopes that I may get some more when I run down to Agege to pay my labourers there. The black-winged species I found here, but they aren't "on" just now. But it's only a matter of time—and good health. There's another quaint group of Psyllid-looking creatures that spin a protective silky web. They also are "corticolous," but are very much smaller. I'll get some of them too.

Feb. 12, 1918.—[Speaking of his first doubtful belief that the insects were allied to *Psyllidae.*] You will gather from my last letter that I *had* doubts, lots of them, but somehow I never thought of looking in Sharp, Pt. I, for them. What upset me was the "frass," which led me to believe them to be mandibulate insects, at least before the imaginal stage (for I have never seen them feed then). I vaguely wondered whether suctorial insects like Psyllids might not have evolved through such forms, and of course didn't take the time I ought to have taken over them. It is a dreadful lesson and I feel so *intensely* annoyed about it. The only Psocids I've ever seen—and I grieve to say I took little note of them—were under cover-glasses in Canada balsam—microscopic things. I *will* try to get more and work out the life-history.

Feb. 14, 1918.—It is remarkable that such wretched soft-bodied animals can live on the same trees as *Oecophylla* with no protection at all in the way of silk.

III. HYMENOPTERA.

[Between 1913 and 1915 Farquharson made many valuable observations on the life-histories and habits of Aculeate Hymenoptera at Moor Plantation; but this work, with the exception of the following, was undertaken under the direct influence of his friend Lamborn, and its publication is better deferred until their joint labours can be communicated to the Society. It would not be right to include one share without the other, and Lamborn's is too extensive for incorporation in the present memoir.]

A. HETEROGYNA.

1. *Notes on Paltothyreus tarsatus F. and Megaponera foetens F.*

[See also Farquharson's earlier notes on these ants in Proc. Ent. Soc. Lond., 1915, pp. v, lvi–lix.]

May 28, 1915.—You will have begun to wonder whether I am ever to send you any insects at all. It is not that I have not tried to get something done, but up till now I have had very little success, partly from mistakes in technique, partly from ill-luck, but in the main from lack of time. My chief bit of ill-luck was with *Paltothyreus.* One morning after a tornado I noticed a large winged ant apparently looking for a nesting-place. I put her into a tin and got her up to the laboratory; I got ready a glass jar with some sand and small stones and cautiously opened the lid of the tin. She had dropped her wings, which I have kept. I put her into the jar and in no time she started to dig herself in. I put live earthworms into the jar, but these also dug themselves in, and as far as I could see, she made no attempt to attack them; in fact, for her large size and formidable appearance, she proved extremely timid. She retreated before live house-flies even. I then killed food for her and put it at the mouth of her burrow. Whether it was dead worms, flies, or Termite soldiers, all disappeared. She distributed them at different levels, and in a few days' time I was able to see a few eggs. These had developed into fair-sized larvae in one or two cases, when something went wrong. Minute mites and equally minute flies attacked the food-supply, and for some time I have seen no other signs of life. Fresh food no longer disappears, but I have not yet opened the nest.

[The following note refers to Proc. Ent. Soc. Lond., 1915, pp. lvi–lxi.]

July 26, 1915.—I was greatly interested in the additional notes from Dr. Arnold's work on *Megaponera* and *Paltothyreus* [in Ann. S. Afr. Mus., vol. xiv, 1915, p. 1], and more than ever wished that Lamborn had been here. We would have gone to every corner of the station where *Paltothyreus* was to be found to check his (and my) observations. Unfortunately I do not know of *Megaponera* here [at Moor Plantation]. Arnold's observations are rather at variance with mine, and I am most curious to know whether Neave and Stigand support either of us, or whether on the East side still other variations in their behaviour occur. I am writing Lamborn about *Paltothyreus*, for he must have been very familiar with their habits. I must say I have never actually heard the stridulation of *Paltothyreus*. It cannot be so marked as that of *Megaponera*, or if so it must very seldom occur here that they stridulate at all. When I made my serious observations on *Megaponcra* (I had previously observed them casually, giving them a wide berth, and put them down as *Paltothyreus*), acting on Lamborn's hint, I was most careful to describe only what I saw, for he had never seen *Paltothyreus* on the march. I doubt if he remembers the incident, for he probably thought I had made a mistake and hadn't given the matter a second thought. I felt, however, that it was up to me to substantiate my story. Merely to stamp on the ground in their neighbourhood is enough to produce the disgusting smell which is so characteristic of *tarsatus*. When I met the big ants on trek this was the first thing I did. The result was the loud hissing and no smell. To make absolutely certain I trod lightly on one or two so as to injure but not kill them, for I had no forceps with which to hold an undamaged one, and I thought from the look of them that a forceps would be indispensable. I then got hold of the damaged ones in my fingers and smelt them at close quarters but could detect no smell, nor could my friend, the late Mr. Owen, whom I asked to confirm it.

I cannot quite understand the "great disparity in size between the two forms composing the colony," which has a "very singular appearance." The specimens which I brought home were typical and so far as I remember do not show a very singular disparity. I did not see the males and females. I had a winged form, or thought I had, of the species, but it got lost. It had emerged I think prematurely. I may have the good fortune of course to see them again, and even to see the actual raiding of a Termitary. By the way, is the prey of the Matabele ant the same species as that of the Nigerian *Megaponera*, because if so the three or four victims that each "usually" carries surely cannot be soldiers? In nearly every case my specimens carried soldiers, and some of the individual soldiers were larger than the ant.

I thought at the time that to carry one and maintain its place in the ranks was no small feat on the part of a single *Megaponera*. I should think they specialise in Termites. *Paltothyreus* does not. I mentioned that earthworms are a common prey, though when a Termitary is broken open they are soon in evidence. My female, *P. tarsatus*, which by the way was ruined by mould or some other agency (I have only the cast wings left), was, considering her size, very timid, and retreated before a soldier Termite, so that I supplied them to her dead lest she herself should be destroyed. These she always carried down the burrow. A wretched big Sarcophagid fly accounted for her larvae, I think. I cannot say I have ever seen them even in a small file, but their nest or colony has numerous small exits with earth borings round each mouth or opening, and they keep constantly foraging round the immediate neighbourhood, each independent of the other.

Arnold really had astonishing good luck to see their migration to a new nest and their queen too. Still I may manage to complete the account of the Nigerian ones. I think it would be well to get a few notes from Lamborn on *Paltothyreus*, especially in regard to the stridulation. It is possible we are all right, but I am glad that Lamborn's innocent challenge led me to take greater care than I might have done.

Sept. 28, 1915.—In the Shagamu district down to Ikorodu (W. of Epe and Oni) I saw lots of the Matabele ants [*Megaponera*], always with the same prey. They are very abundant round there and are called by the natives (Yorubas) "Jamjogu" (syllables all of equal length), which signifies "fighting" or "warlike." I had no opportunity of getting at their nests. I got a few more specimens.

2. *Notes on Camponotus maculatus F., var. melanocnemis Santschi.*

[Material:—A long series of ☿☿, varying, although not greatly, in size, taken May 25, 1915, from a nest in an old Termitarium in the decayed base of a large tree. It is probable, although not certain, that the tree was the one referred to below as cut down on May 28. For the relation of this form to Lycaenidae see the notes on *Catochrysops phasma* (p. 392) and on *Lachnocnema bibulus* (p. 388). The ☿ ant attending a pupa of this last Lycaenid came from the same nest as the above-mentioned series.]

May 28, 1915.—We have been having rather heavy rains to date. My last piece of entomological news relates to ants again. To-day a large tree was felled here, and in the decayed base of it was a nest of what I take to be *Camponotus maculatus*, var. *melanocnemis*. I failed to find the queen, but I got larvae in all stages as well as pupae, the latter being in pale flesh-coloured cocoons of very thin texture. I will send you, this mail, specimens of larvae and cocoons as well as soldiers and workers. What puzzles me is, that last year we had an extraordinary flight of winged forms which Dr. Lamborn took to be of this variety. They were very large insects. A few winged forms came from prematurely ruptured cocoons to-day and they are quite small. However, I have secured a large number of pupae, larvae and adult forms, which I have put into a box with wood from the same tree—in fact, the portion where the nest was, which had been previously tunnelled by Termites—and they appear quite at home. All the pupae and larvae are stowed away out of sight, and the adults are now gorging themselves with sugar at eleven-and-six per stone. They ought to do well.

March 1, 1917.—When I went down the other night well after dark to look for evidence of night-feeding [by *Tera-*

toneura imagines, p. 349], I went to the *Cremastogaster-Argiolaus* tree and was surprised to find the large *Camponotus maculatus*, ? var. *melanocnemis* running all over the tree. I remember cutting into a bit of the decayed heart last tour and causing a hurried sortie on their part, but I had forgotten that they lived inside the decayed heart. They appear to be night-hawkers. It is rather extraordinary considering their great size and heavy armament in the way of jaws. But, although *Cremastogaster* never seem to stop, I visit that tree every day and never see one *Camponotus*; yet that night they were all over it. Yet the nuptial flight finds the fliers in a markedly phototropic mood, and they are a dreadful nuisance now and again in the house. The flying stage is such a large insect. They always come about dinner-time, 8 p.m., and I have to shut doors and windows at the risk of suffocation. One can actually hear the patter of them at the lighted window, reminding one of a shower of hail at home.

Sept. 16, 1917.—*Camponotus maculatus* is a nocturnal ant. One occasionally sees workers in the open on plants in the daytime, but very seldom are soldiers to be seen. I know of a nest at Ibadan in an old tree from which I can make a few outraged soldiers emerge at will by thrusting a little twig into the opening—a sort of friendly call to make sure that my friends are still to the fore. But at night the whole neighbourhood of that tree is alive with them, soldiers and workers too. In spite of their great size and heavy armament, these soldiers are singularly timid. They cover the retreat rather than pursue aggressive tactics. A Driver soldier will bite at one's bootlace or puttee in impotent fury, and even the relatively tiny soldiers of a *Cremastogaster* colony make for the enemy at sight. *Odontomachus* hasn't got such a name for nothing. He lives up to it. As for *Oecophylla*, at the first alarm the whole crowd come out on to the surface of the nest ready for action, all facing the enemy. I have often amused myself " drilling " them by moving a little twig from side to side just an inch or two (or even at considerably longer distances) in front of them, moving it like a precentor his baton. At each change of position their heads and bristling antennae are turned simultaneously. One can do the same with a Mantis, but he somehow is a comical spectacle as he orients his head; *Oecophylla* inspires respect, and so does *Megaponera*. There are two or three nests of them here now, and I really do think it is a horrid libel to apply the adjective "foetens" to them. By-the-way, did I tell you that Mr. N. H. Thompson, the Chief Conservator of Forests, agrees with me that they do not "stink away the enemy"? I think I came on that phrase somewhere in Sharp the other day. If man be the enemy, how true that is of *Paltothyreus*! An alarmed colony of *Camponotus maculatus* forthwith sets up a great tapping, which is most distinctly audible on the hard stem of a tree.

Sept. 18, 1917.—About *Camponotus* one other note. Lizards are extremely fond of them, the workers at least. Daytime stragglers are eagerly snapped up. A tiny *Agama*, running about near the door of my bush hut here, came and carried away some of those from my carton material which had escaped from the box.

Is it not odd that the asexual stages should be so markedly lucifugous while the sexual individuals are as markedly phototropic? Earlier this tour, I think about March, I was at a place called Oyo (Awyaw) about 30 miles N.W. of Ibadan. Just as it was getting dark one evening I saw the beginning of a nuptial flight of *Camponotus maculatus*. They also were issuing from a small hole in the ground. (If I get back to Oyo at all I'll seek out that place again, for other [Lycaenid] reasons!) As in the case of the Termites the soldiers also came out in force, covering the ground for some distance round the various craters, for the nest had multiple openings. The winged forms didn't start off immediately on emergence, but many went back into the nest, though it was impossible to tell whether or not they came out again.

3. *Artificial Ants' Nests: Inquiline Mites.*

July 26, 1915.—I have tried my hand at an ants' nest, but we have very little plaster of Paris here, and what there is has gone off a bit and my first nest hasn't set. I'll describe it later, but meantime it contains a fine little family of what I take to be a Camponotine which I got from a newly felled palm. They are small ants about the size of our house Pheidoles, black, and run about with extraordinary rapidity. I secured two apparent females and one or two workers with a lot of cocoons, for the pupae are in little white cocoons. I am greatly afraid of mould, but am to try another form of nest. Meantime they are doing well and like brown sugar. What is more, they are parasitised in several cases by a sort of preserved-strawberry red mite. One or two have two or three or four mites, and I think, so far as I have observed, the mites take up a symmetrical position on the pedicel. There is a much larger fat-looking mite moving about among the débris, which I'd like to prove was the female parent. With a little luck, however, I may make something of this lot. I have also another family, with naked pupae, of an extremely minute red ant, hardly over half as big as a *Monomorium*.

Aug. 11, 1918.—[Probably referring to the above nests.] Another thing I was keen on working up was the mite inquilines on one of the Pheidoles here, not the house one. I found them duly arranged as described in Wheeler, on the callows of the species, but my nests were destroyed by *Monomorium* and I never got the chance to set up new ones.

B. FOSSORES.

Ammophila lugubris Gerst. (*beniniensis Beauv.*), *its Prey and its Enemies.*

[Material :—*Ammophila lugubris* (Proc. Ent. Soc., 1918, p. cxxxvi)—1 ♀ labelled "No. 2.—30.v.1915," accompanied by the relatively large stone plug of its burrow and one of the Tachinid flies bred from its prey. The fly, which is labelled "Tachinid fly, emerged 20.vi.15," is the type of a new species described by Dr. Villeneuve on p. 518 as *Hilarella helva*.]

May 31, 1915.—Yesterday I saw a most interesting sight. A wasp, I think an *Ammophila*, was dragging a Noctuid larva along the ground, with a view to burying it, and I stopped to watch her. Closely following her was a Chrysid. The wasp selected a place for a burrow and started digging, the Chrysid sitting close at hand. This wasp digs a very shallow nest and soon proceeded to stow away the prey on which she oviposited, as I afterwards found. Instead of filling the nest with the excavated earth she came back with a small stone and was just about to place it when a small fly, most probably a Tachinid, for it happened so quickly that it was all over before I had time to attempt to catch it, swooped down and appeared to drop her egg or eggs on to the tail of the larva which was just visible. The wasp simply placed the small stone and went off to get another. As she was placing this I captured her. The Chrysid I lost. I dug out the larva and saw the wasp egg, but at the time saw no sign of the Tachinid egg. I did not do a careful examination, for

I didn't wish to expose what I had got to the sun. I thought the fly ova had been lost in the soil. The wasp egg was placed about the middle of the host body and was quite conspicuous. It could not have been seen without digging out the larva. Yet shortly after, when I reached my quarters, I observed signs of life beside the wasp egg. Four or five minute maggots were "crowding" round it. To-day the wasp egg has disappeared, as far as I can see, and the maggots appear to be trying to enter the larva. Now, unfortunately, there is a doubt as to the fate of the wasp egg. I think the maggots accounted for it. But the moth larva though unable to crawl is capable of a very strong reflex, and, as the maggots try to penetrate it, it jerks with vigour, and I have not been able to confine its movements as they would be in a cell in the ground, and the egg may have been damaged in this way. On the whole, however, I think not, for the larva was unable to roll over so that the egg would be underneath, and the egg could not come into contact with anything above. It was interesting to note that the larva, though it couldn't crawl away, could yet function in another way and excreted about fourteen faecal pellets. This would, I take it, materially assist its parasites by checking decomposition. I shall try to rear the flies, and if I succeed will be sure to send them on. I'll know by next mail, I think.

July 3, 1915.—[Referring to the material despatched.] No. 2 is the wasp of which I told you. Her prey had 4 or 5 viviparous Tachinid larvae dropped on to it as she was just about to close the nest. I failed to get the parent Tachinid which worked with such extraordinary suddenness and rapidity. None of the other flies have emerged, though I can see the pupae more or less distinctly.

[Comparing this statement with that of May 31, it must be regarded as uncertain whether the Tachinid larvae were deposited as such or emerged from quickly hatching eggs.]

C. DIPLOPTERA.

Odynerus lateralis F., building its Nest in a Teapot.

April 24, 1918.—I've just noticed a most extraordinary and very funny thing. I've a strong weakness for tea. It is the finest restorer in the world (closely followed by a bath) and, even in this rather hard-living part, most men confess that they'd miss any "meal" of the day rather than tea, so I keep a reserve of teapots. Hearing a buzzing noise over by the sideboard I saw a *Rhynchium* [*Odynerus*] *laterale* in the very act of going down the spout of one of the "reserve" pots. I have just discovered that the inner holes at the bottom of the spout, are "built up" with mud and the mouth of the spout in process of being also built up. It is my "going away" pot. I must remember to warn the boy next time I travel to Agege. These wasps are the most persistent animals. *Vespem* "*furca*" (any convenient missile or newspaper) *expellas, tamen usque recurret.*

IV. COLEOPTERA.

1. *Colour Associations of S. Nigerian Mylabrid Beetles.*

[The first three paragraphs refer to the species of an Ibadan colour-association, described in Proc. Ent. Soc. Lond., 1916, pp. xcix–cx, pl. B.]

May 3, 1917.—The suggestion that it was the sterile flowers that were eaten is correct [Proc. Ent. Soc., Lond. 1916, p. ciii]. I may say that just lately I have seen one or two forms on the flowers of native Convolvulaceae, which are abundant here and elsewhere in the Colony.

Lamborn suggests that the larvae may feed on the ova of the Acridian *Zonocerus variegata*, but before I'd got his letter these had disappeared for the season, but I will bear it in mind.

Dec. 12, 1917.—Do you know, a few months ago I had to go about the day after I had seen two *Decatoma affinis* Ol. (type) ovipositing! I had perforce to go away and leave them. I saw the ♀s digging holes in the ground like Fossorial wasps. One oviposited about 6 or 8 inches down, a mass of yellow sticky eggs. [A. Loveridge describes, in Proc. Ent. Soc., 1921, p. xc, the large *Mylabris oculata* Thunb., var. *tricolor* Gers. ♀ ovipositing in a hole about 1 in. deep.] I had hoped to follow up a tip from Lamborn to look for them in contact with Acridian ova, but they were in contact with nothing that I could find. The other ♀ was just starting to excavate. That is only one of many disappointments.

[The remainder of this section describes a somewhat different Mylabrid association from another locality. The material is tabulated in detail on p. 432. The species were kindly determined by Mr. K. G. Blair with the able assistance of Mr. H. Britten in the preparation and examination of male genitalia.]

Agege.

Oct. 17, 1917.—I am only here for a day or two waiting for a boat from Lagos to Port Harcourt, from which I go up the new line for a bit and then strike east to Okigwi.

Port Harcourt.

Nov. 15, 1917.—I believe I have found still another facies of the *Decatoma-Coryna-Mylabris* complex. I won't be able to send them from here as they are not dry yet, but I will I hope manage them for the next. I'm afraid they will be all I'll be able to send for my Xmas gift, but I couldn't get a chance to do better. For most of the time I was travelling in country that is rather unsettled, besides being entomologically and mycologically rather arid—grass country. The treks were long and I had to keep in touch with unwilling carriers who were, not without reason, afraid to go twenty miles from their own village to the next rest camp. At this time of the year in these parts and over to the Cross River (that is in the Udi and Okigwi districts, east of the Niger, north of here about 100 to 150 miles) there is a notable head-hunting ju-ju in vogue. I believe the hands of the village belles are only given to youths who have sufficient enterprise to secure the head of some other tribesman. The limits to which "auri sacra fames" will push a mortal man are nothing to what Eros can do in these parts. The victims do not get a clean, straightforward death (nor even a quick stab in the back). They are subjected, I believe, to not a little ceremonial torture of a very dreadful kind. It is odd to think of this happening within ten miles of a railway. But I am getting away from my subject. I have got forms like some of those at Ibadan (*Decatoma*, I think), but others with the yellow bars on each elytron reduced to two yellow dots, the antennae black with a red tip, otherwise very closely resembling the Ibadan forms. I have got one or two others of other kinds, but unfortunately none *in coitû* and not a great series, for I simply had to snatch at them as I went along wherever their food-plant, a Convolvulus, occurred. As far as possible, too, one gets as much of one's trek in before the sun gets too hot, and, in early morning, say up to 8 or 9 o'clock from 5 a.m., they are hard to find. They rather like the sun and were not to be found in the heavily shaded palm groves. But they may prove to be of interest, and some day I may get a better chance to add to them.

I must now catch the mail. Port Harcourt you may not be able to find on the map, but it is located on a creek that enters the sea at Bonny, and is, I suppose, about 40 miles north of that place. It is one of the most important places in Nigeria, being the terminus of the new Eastern Railway which runs up to the Udi coalfield. An account of the latter you will find, I think, in a fairly recent issue (not more than 12 months old, I think) of the "Bulletin of the Imperial Institute." Part of its way, the railway taps districts enormously rich in oil-palms. Quite large cargo steamers (up to 7000 tons, at any rate) can come up here. Within a stone's throw of where I am now two considerable vessels are loading up coal and oil. Nigeria is undoubtedly a great imperial asset, and yet one meets people at home who have the vaguest notion of where it is on the map, or who think it is a part of Sierra Leone, a place called the White Man's Grave. I have even seen a review of our Department's annual report in an important paper, headed "Agriculture on the Gold Coast" !! I wonder if the Germans were as hazy about the Cameroons. I hope I may be able to make a little of it known to naturalists if only I could get a little more leisure.

Moor Plantation.

Dec. 9, 1917.—One of the boxes (for I sent two) contains the first batch of the new *Decatoma* facies of which I wrote you at Port Harcourt. I had to pack the specimens hastily on a false rumour of the mail going, but I hope enough will reach you intact for diagnostic purposes. I have kept some in reserve, but some of the larger forms I cannot replace. There are two which differ from all the others and from each other [*Mylabris afzelii* Bilb.]. They are the only ones I could get. I will first tell you where to find the places on the map. If you can find Onitsha on the Niger, well up towards the boundary between N. and S. Nigeria, the rest will be easy. Due east from Onitsha (22 miles by road) is the town of Awka. Still going eastward and a very little north you will find Udi, which is rather over 30 miles from Awka. Udi Government station is about 1200 to 1500 feet above sea-level. You will see that the road from Awka crosses a range of hills at Udi—the range running due N. and S. About 11 miles east of Udi is the new Nigerian Eastern Railway, not shown even on fairly recent maps. If you follow the ridge of hills northwards, about 12 to 15 miles, perhaps, direct and a little to the east, you will see a place called Enugu Ngwo.

That is where the great coalfield now being worked by the Government is located. The railway runs from Port Harcourt to Enugu, the present rail-head. Port Harcourt is at the head of the Bonny River and is practically the same as Okrika, which you will see on the old maps. I went to Enugu by rail, then took the road to Awka, which meets the Udi-Awka road at Oji River crossing. This involves a 26-mile trek in one day. The next day's trek took me to Awka, where I remained a day or two and was then hastily recalled back here to take over from the Director of Agriculture, who is going home by this mail. I returned to rail-head by a route which took me through Oji River and Udi. For the most part the whole area is grass country, except in valleys which carry heavier vegetation, or would if they weren't largely farmed. Palms (oil), however, are abundant and indicate the more fertile valley conditions. The "Decatomas" were not found in the more heavily shaded places, nor yet in the drier almost pure grass lands, but rather in the intermediate country. Owing to a faulty bicycle and the necessity to keep up with my carriers I could only—almost literally—grab at specimens as I passed along; wherever I saw the Convolvulus, which is their favourite food, I would stop for a minute or two and then hurry on, not favourable conditions for intensive work, but perhaps favourable for the discovery of the dominant types. I had certainly no time to select. Unfortunately I could not obtain a single pair; never saw any. On the day when I found the two unique specimens [*M. afzelii*] or rather the forenoon of that day, I found very few of any kind. The morning had been wet, and the species are distinctly sun-loving. The few I found were hiding under leaves. It may, of course, be that they knew the uselessness of looking for open flowers in the rain. Dull weather markedly retards the flowering of many plants (*e.g.* cotton). Such Convolvulus flowers as do open—they are campanulate in shape —fill up with water, swamping the ovary and anthers, the food of the beetles. The corolla is also eaten. In the circumstances I would not venture to say what environment conditions the dominance of any type. I would almost hazard a guess that altitude has not a little to do with it, but I had to give nearly all my time to the subject of coconut disease, which was the reason for my being there at all.

Jan. 12, 1918.—This letter is simply an appendix to the last one. I just heard to-day that a supplementary mail was going, presumably by some intermediate cargo boat.

Perhaps the next direct mail will get there before it. I haven't time to put up a box, but I wouldn't have risked it anyhow. I am glad to say that I had no mails on the "Apapa," that I know of at least, and I believe my last parcel has got safely home. Two or three of the Decatomas were unique and I haven't got duplicates to send.

I got the papers from the Entomological Society, and have to thank you so much for getting me elected to its fellowship.

March 2, 1918.—The "Appám" (now called the "Mandingo") took home the Decatomas. I hope these will get as good luck. I only wish I had more to send.

April 28, 1918.—The Decatomas apparently complicate the original complex. I wish I could have got pairs, but it was impossible. The Ibadan ones are now beginning to appear, and I hope to make a collection of pairs this season.

[The Mylabrid beetles, belonging to five species, are tabulated below according to locality and also the order of time. Precise dates are not available.

Captured (mostly in Convolvulus flowers in strong sun), Nov. 1–15, 1917, in the order of time I–IV).	*Coryna chevrolati* Beauv.	*Coryna hermanniae* F.	*Mylabris tibialis* Mars.	*Mylabris vestita* Reiche, or close to it.	*Mylabris afzelii* Bilb. (nec Mars.), var. V.
I. Road from Enugu Ngwo to Oji River crossing on Udi-Awka road.	19				
II. Road from Oji River crossing to Awka.		3	3	3 (2 melanic and 3rd darker than any in IV).	
III. Road from Awka to Udi.	43		1		1 (Anterior half of elytra orange, posterior black).
IV. Road from Udi to Enugu Ngwo.		1		9 (1 with trace only of anterior black bar).	1 (As above, but trace of posterior orange bar, stronger on L.).
TOTALS .	62	4	4	12	2

The general appearance of the Awka-Udi association, with the exception of the 9 *M. vestita* in IV., is much darker than the Ibadan series illustrated on Plate B of the 1916 Proceedings. The latter, in fact, gives an impression of orange insects with black bars, the former of black insects with narrow yellow or orange bars, which in *C. chevrolati* are broken up into spots. The two *M. afzelii* and two of the *M. vestita* in II., however, have lost the appearance of barred forms, the latter being melanic, with only faint traces of orange, the former orange anteriorly and black posteriorly, thus resembling, although much darker than, the vars. of *D. affinis*, *M. hermannioides* and *M. farquharsoni* in which the anterior black elytral band is wanting (Proceedings, 1916, pp. cvii–cix). The much blacker appearance of *afzelii* is due to the posterior orange bar being obsolete or absent. One of the 9 *vestita* in IV. resembles the Ibadan forms of the same variety.

Comparing the size of the beetles in the two localities, *M. afzelii* is much larger than any of the Ibadan series, *M. vestita* of about the same size, the other three species considerably smaller, this being true of the four examples of the only species common to the two—*C. hermanniae*, which is smaller as well as darker than the Ibadan average. It is probable that the Ibadan *hermanniae* has converged towards *D. affinis* and the dominant *M. farquharsoni*, the Awka-Udi *hermanniae* towards *M. tibialis* and the dominant *C. chevrolati*; but much larger numbers are required to test this conclusion thoroughly. Larger numbers are also required in order to determine the extent and the meaning of the difference indicated by a comparison between the three specimens of *M. vestita* from locality II. and the nine from IV.

The Mylabrid beetles here tabulated were accompanied by seven examples of a fine Homopteron, the Cercopid *Locris maculata* F. with the label "widespread in the Awka-Udi districts, also at Ibadan." Six of these are yellow, black-marked insects with considerable general resemblance to but less dark than the Mylabrid vars. which have lost the anterior black bar; the seventh is nearly melanic, the yellow being reduced to two narrow bands made up of small spots. This form resembles the two melanic *M. vestita*. A further collection with precise localities would be of much interest.—E.B.P.]

2. *Erotylid Beetles aestivating in the empty Clay Cells of an Aculeate Hymenopteron.*

[The observation on *Episcaphula interrupta* Lac, recorded in Proc. Ent. Soc. Lond., 1913, p. cxxii; 1914, p. xxiii, is so curious that further details are added from Farquharson's letter. The first and last sentences refer to a suggestion that, as *Erotylidae* are fungus feeders, the supposed cells might have been fungi.]

Feb. 10, 1914.—It sounds almost like libel to suggest that I confused clay cells with a fungus, which some one seems to think must have happened in connection with the discovery of the Erotylids. It is fortunate that Dr. Lamborn saw the actual cells. Perhaps the vagueness of my note misled them. I may briefly recount the circumstances. While examining a stump by the side of a small stream for Mycetozoa I came across two small cells of the "Potter" class. Frequently the bottom of these cells is not of clay but is simply the flat surface of the object (wall, log, etc.) on which the cells are built. Or the cells may only be partly "floored" with clay, as if the builder were simply adding a little for levelling purposes, so that on prising off a closed cell the larva or pupa may easily be seen. The first of the two cells that I prised off was of this order, and, as soon as it was detached, the beetles started to come out. I hastily put the lot, cell and all, into a closed box. A little wood from the stump came away with the other cell, and as the "lid" of the "pot" was stopped, loosely, I think, with débris and not with clay, and nothing tried to get out, I simply put it into my vasculum. In the evening, when we came to compare notes as usual, I handed the cells to Dr. Lamborn. On opening my vasculum I found that the Erotylids were just beginning to come out of the second cell. Of the composition of the cells there was no doubt. They were of clay. At the time, I think, we concluded that the beetles were aestivating. I think we dismissed the idea of their having been stored by a wasp, as they were extremely lively on issuing from the cells. I fear I can throw no further light on the matter, but I think that if the B. M. authorities make such dreadful suggestions I shall seriously consider the question of sending any more Myxos!

3. *Notes on the Life-history of the Endomychid Trycherus flavipes Arrow.*

[The species was described from Farquharson's bred specimens in Trans. Ent. Soc. Lond., 1920, pp. 10, 11. Material:—2 ♀, emerging Oct. 9, 1917; 2 ♂ 2 ♀, Oct. 17 (1 ♂ 1 ♀ with precise pupa-cases); 2 larvae in spirit. All from Agege. A ♂ (the type) and 2 ♀ are in the British Museum.]

Agege.

Oct. 18, 1917.—On the same Agege *Hewitsonia-Argiolaus* tree [*Antiaris africana*] I found some curious little spiny Coleopterous larvae that the ants seemed to leave alone. These run about freely, and not really very rapidly, apparently being able to take their own time, regardless of the ants. They pupate on the bark, in tiny pits or crevices. In one case I got two just beside a *Hewitsonia* pupa. Till yesterday I only had two pupae. These I got before going to Ibadan at the beginning of this month and they bred out there. I sent one as they were scarce, but now I shall have half a dozen at least, I think. I have decided that they are Endomychidae. One emerged yesterday evening about 8.30, and this morning there were two in addition. When newly emerged (the first one) it was whitish in colour and the wings were for some time kept unfolded and projecting beyond the elytra.* It seemed to me to be an amazingly large animal to have come out of such a tiny pupa-case. The Endomychid larva (if I have correctly classified it) appeared to feed just as the Hewitsonias.

Moor Plantation.

April 17, 1918.—I am so glad that the Endomychid was workable after all. [Mr. Arrow considered that the colour of the first specimen shown him had not quite matured.] They must take a good time to harden, for I left them, in one or two cases, at least 24 hours before killing. However, I'll probably get better material this year again.

Aug. 11, 1918.—By the way, I found the Endomychid larvae on the *Cecidomyia* tree [p. 442] to-day and have got one pupa. I am sure it is the same one as I get at Agege. [Young larvae were again seen on the "ant-tree" on Aug. 25.]

4. *Dermestes Larvae and Mites in Cremastogaster Ants' débris at base of "Ant-tree."*

Aug. 25, 1918.—While I was stooping down for a tin I noticed one other thing. At the bottom of the tree is the ants' "kitchen midden," full of the usual débris, chitinous rings of all sorts of dead insects and goodness knows what else. I noticed the surface "heaving" and proceeded to investigate. I expected Dipterous larvae like those I got on the refuse heaps of *Paltothyreus* at Agege [see pp. 519–20], but instead I found brownish rather maggot-shaped larvae with rings of brown bristles, but whose head end was the broad end, the posterior end tapering to a point with long golden bristles. I could see no head (as they shammed dead, I at first thought they were Dipterous pupae), and indeed so far I have not examined them closely. But they have thoracic legs and run about quite actively after their initial "sham." Their shape is very *Lepisma*-like without the "tails," and I think they are Coleopterous. I am hoping they are nearly full-grown. I am to leave them with Dr. Connal on the off chance that they may breed out, and will take a few larvae with me. I could easily have obtained dozens of them. Incidentally the "refuse" was simply crawling with mites, and when I opened the tin this evening to see how things were doing, I was astonished to see that these had all congregated to one spot on a round piece of débris which looked like a round reddish-brown ball, so numerous were the mites. The lamp-light made them scatter and bury themselves at once.

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* The following note was written Oct. 18, 1917, at Agege: "Just lately I have been breeding out a Coccinellid that feeds on *Aspidiotus destructor*, the pest I am going to Okigwi to investigate. They do not appear to expose the wings after pupation [like the above Endomychid] but sit as still as a Coccid and looking like one."

5. *The Life-history of a Drilid Beetle, probably Selasia unicolor Guér., bred from Snails.*

[Material :—In spirit, a large apterous ♀ probably of *S. unicolor* and a bristly larva similar to the one from which it developed. These larvae are well known in African collections and have long been suspected to be the immature stage of the Drilid, *S. unicolor*. Farquharson's notes make this conclusion highly probable, but it is to be hoped that male larvae will be found and bred.

Mr. K. G. Blair writes : "The *Selasia* ♂ is a VERY much smaller insect than the ♀ in question, and must come from a very much smaller larva. This disparity of size is really not contradictory to the specific identity of the two insects, as in our *Drilus flavescens* the disparity is almost as great. The larvae of the two sexes are also very different in size, and, like the *Selasia*, feed on snails, hibernating and pupating in empty shells of their victims, but they do not appear to bury them as does the *Selasia*.

"We have a note by Dr. F. Creighton Wellman attached to one of these larvae from Angola :—

" ' The natives state that if you step on it with bare feet the bristles pierce the skin of the sole and work into the flesh, causing inflammation and even gangrene. Native name "*O-cisia*" (= noli me tangere). I have seen a whole caravan of porters warning each other in this fashion when an O-cisia was in the path: "Step to the side! There is an O-cisia!" ' "]

May 28, 1915.—Last year Dr. Lamborn bred from a large snail which flourishes out here a number of beetles—*Drilidae*, I think. I never saw them. It was before I came back from leave. One day a week or two ago I saw a curious-looking larva—I had seen them before without understanding their significance—quite near to a snail shell. I had been in hopes that I might one day see Lamborn's beetles in operation. I am not sure whether he saw what I am going to describe, but if it is old news it will at least be independent corroboration. The larva is a rather flat active creature, which I will describe when I send you a specimen. I sat down to watch its movements. It ran round the snail once or twice and then crawled on to the top of the shell. It then appeared as if it were about to crawl off again, but its posterior end remained attached to the shell while the head and legs were on the ground. To my surprise it proceeded to push the snail backwards by extending its own body, in a manner recalling the Scarabs, except that the snail was shifted bodily and not rolled or trundled. I concluded that the victim was being carried off for burial, where the earth was soft, for all this took place on a hard path. I put both together into a tin with some earth, and reached the laboratory about an hour later. When I opened the tin I found the snail nearly buried by a process of undermining. I half-filled a larger box with sand, into which I turned the two and watched the process in comfort. When the undermining was in progress the unfortunate snail ventured out, but the enemy doubtless feeling the strain, for the sucker pseudopod never let go, turned round and drove the victim well home. In about an hour's time the two disappeared underground. Nothing has happened since. I have, however, secured three or four more larvae, which I supplied with snails. They, however, didn't bury them, but started their unpleasant work right away. I am in great hopes that I may get a few mature insects to send you.

July 26, 1915.—Now another note about my snail parasite. This was the doubtful *pièce de résistance* of last mail. The bristly larvae after a time emerge from the empty snail shell, minus bristles of any sort. They are like a large rather soft-skinned larva [the apterous ♀], very bloated in appearance, with curious short antennae and a more curious appendage at the posterior end. One of them one day oviposited a mass of sticky yellow eggs and died. The eggs are sulphur yellow when fresh. They are undoubtedly eggs and the larva [♀]—a large thing over an inch in length and nearly half an inch broad—is absolutely apterous. But I've seen no males, and I think the oviposition may be parthenogenetic. I have them in a flower-pot covered over with mosquito gauze. The worst of it is they won't feed. Another has oviposited and died, and I have failed to get the eggs to develop, owing to mould or want of fertilisation. From the first box in which I had them it is possible that a smaller winged male might have escaped. It was not protected by gauze, and the wooden box warped. However, I am in hopes that I'll manage to complete the cycle. Material in the form of the bristly larva is plentiful.

I wonder if you could let me know what sort of a creature the Drilid *Selasia unicolor* is which Lamborn bred (by accident) from a large snail. It was before I met him last tour. I think if it had been this extraordinary apterous creature he would have told me of it. Only he told me so much that I may have forgotten.

[Lamborn bred a female Drilid, evidently the same form as Farquharson's, from a larva to which a snail was given, in mid-June, 1913. The larva-like female emerged July 31, and was determined as probably *S. unicolor* by Dr. Marshall, and the snails on which it feeds as *Limicolaria* sp.]

Nov. 24, 1915.—I got off a specimen of the snail-parasite, larva and mature ♀, with a few ova. The latter are sulphur-yellow when fresh.

[In later letters he spoke of his hope to breed the male beetle, and, on April 28, 1918, of noticing numbers of the larvae. The last reference, shortly before he sailed from Lagos, is as follows :—]

Aug. 11, 1918.—Looking back over the 22 months, it is very little that I have been able to do. I had hoped to clear up the *Decatoma* life-history, the snail-parasite, and I don't know how many other things, but at any rate I've got clues to work on, and, if I do not get the chance, perhaps somebody else will.

6. *A Carabid Larva attacking a Snail.*

[Dr. C. J. Gahan, who has examined this fine Carabid larva, informs me that it is impossible to determine its genus.]

May 28, 1918.—While at Agege last I noticed a fairly large snail climbing up the wall of an out-house. I was attracted by its apparently " frothing " or blowing bubbles as it climbed. It fell down, and looking at it I found that it was attacked by a very large Coleopterous larva which I have sent you—if it is a larva. It is a horrid-looking creature. I tried to feed it up or give it a chance to oviposit, but it died, so I " spirited " it away. I left the snail in the tin in case ova had been laid, and now find that a large Dipteron had been there. I do not think it can have become infected while I had it. But the pupae are there, and I may get them bred out.

7. *Procryptic Beetles, probably Passalidae.*

July 3, 1915.—In a dead palm which had just been felled I got three very odd-looking beetles. They are very flat and hard, which I imagine is a special adaptation to permit of them getting between the closely pressed leaf-bases of the palm, where they were found.

8. *Beetles accidentally introduced in C. O. Farquharson's Consignments.*

[The following beetles were found in the cotton-wool or among the " papers " in a package received in January 1918:—CUCUJIDAE: 12 *Cathartus advena* Walt.; 2 *C. cassive* Reiche; 3 *Haemophloeus pusillus* Sch.; 1 *Silvanus surinamensis* L. CURCULIONIDAE: 1 *Calandra oryzae* L. SCOLYTIDAE: 1 *Taphrorychus bicolor* Hbst.

Loose in a box received in July 1918:—PTINIDAE: 1 *Lasioderma serricorne* F.

Loose in a box containing a pupa of *Teratoneura*, parasitised by small Chalcids (p. 459), received in 1917:—CORYLOPHIDAE: 2 *Sericoderus lateralis* Gyll.

The species were kindly determined by Mr. G. J. Arrow.]

V. DIPTERA.

A. THE HABITS OF TWO NEW MYRMECOPHILOUS CECIDOMYIDAE.

1. *Farquharsonia rostrata Collin, gen. et sp. n.* (p. 505).

[The material includes 6 ♀, captured April 13–15, 1918, at Agege (152 ft.), 16 miles N. of Lagos, together with 2 ☿ maj. and 21 ☿ min. of *Cremastogaster buchneri*, r. *alligatrix* from the carton nest over which the Cecidomyids were flying. Also, from Moor Plantation, stealing from ants on carton nests—2 ♂ 3 ♀ taken Aug. 8, 1918; 7 ♂, together with a sample ☿ of the ants, near race *alligatrix*, taken Aug. 10; and 10 ♂ 8 ♀ taken about August in the same year.]

April 17, 1918.—Your letter of early March arrived safely, having been a month on the road, but we are always glad when the mail gets here at all. I have not been able to send anything for some time, for I have been very busy getting in the crops now that the rains have broken. However, I hope to get a small collection together soon. I think I shall manage to get you some more interesting Myrmecophilous Diptera. Last week-end I had to go to Agege on my monthly visit, and went as usual round the few *Cremastogaster* nests within reach. I got no Lycaenids, but I was able to study the doings of a number of yellowish-brown midge-like flies that kept constantly flying over the nest and indeed within the labyrinth of the carton. Observation as to their exact doings was extremely difficult from their colour and from the fact that they didn't alight at all but remained almost like Syrphids, though not for so long at a time. At other times they kept up a dancing flight till their immediate object made them at any time approach the nest. I was at last able to satisfy myself that the objects of their interest were ants that were in the act of feeding each other by the usual method of regurgitation. Seeing these on the surface of the carton or in a crevice of it, one of the tiny flies would immediately approach near enough for its head or proboscis to be in touch with the ants, and though, from the fact that they were rather shy and didn't actually come to rest, I could not actually succeed in seeing them appropriate a share of the food by sheer theft, yet I have not the slightest doubt but that they did. *Harpagomyia* doesn't alight on the carton, which is always much too lively, but hunts on the stem of the tree over the "run" of the ants. The food exchange is quite leisurely and friendly. I brought away a few of the flies with me and found them to be Nemocerous Diptera—apparently, and if Nemocerous Diptera, I regret to say that with much thought and misgiving I can find no family for them except Cecidomyidae, but, mindful of former misfortunes, I do not venture to say more than that they are Diptera. The antennae appear to have twelve or thirteen segments, with whorls of bristles, and are divided up by beautiful areolate markings. The venation of the wings is extremely reduced. The proboscis is quite a huge and rather remarkable affair, but you'll see them for yourself when they come. I hope to send them next mail. I haven't exhausted the Myrmecophilous Diptera yet, and am keeping them back so that I may send others with them.

[Farquharson had hardly posted the above record when he heard that his friend Mrs. Connal considered that the Diptera were *Ceratopogon*, with biting mouth-parts. He wrote later, on the same day, in some depression at what he thought must have been his mistake, but recovered to some extent when he began to recall the observed facts.]

April 17, 1918.—I can see what insects *do*, and I'll tell you nothing but what I see. I am by no means sure that the biting mouth-parts are actually used for biting. I am almost certain that my interpretation of their movements is the correct one. There would be no object in specialising *in pairs of ants* in the act of inter-regurgitation. I have written to ask Mrs. Connal if she will describe it and if so to allow her diagnosis to be published with the rest. I will send specimens next mail. The hind-legs, by the way, are carried like those of Culicidae.

Aug. 11, 1918.—It cheered me very considerably to write Dr. Connal that the Diptera *may* after all be Cecidomyids. Poor man he wrote me at the time that he had been made the " object of unlimited scorn " from Mrs. Connal over the mis-diagnosis. I think I told you that I have found them here also [Aug. 8; see p. 440], and, after very carefully watching them, I feel certain that my original view of their activities holds. They hover, with midge-like flight, as close as possible to the ant-nest, frequently going right into the outer cavities of the carton, till they see a pair of ants in the act of inter-regurgitation. They then dart forward a little, their wings all the time being in rapid motion, till their heads appear to be in contact with the point of contact of the ants' heads. What exactly happens I cannot say for certain, for they are harder to observe than *Harpagomyia*. But I'm sure they don't even try to bite the ants, and I can hardly doubt but that their object is to steal the " droplet " that one of the ants intends for the other. I am confident that I shall see this happen. It is only a question of waiting till I can see the flies side-on. At any rate I am certain that only pairs of ants at regurgitation interest them, and that they never tackle solitary ants like *Harpagomyia.* Nor indeed do they ever come to rest on the surface of the trees as the mosquitoes do. (The mosquitoes keep in motion when actually soliciting food, but when not begging they frequently settle down on the trunk of the ant-tree.) Their hind-legs are backwardly directed when in flight, not unlike mosquitoes' legs, but their flight is rapid and dancing. I have spent a good part of to-day at one of the ant-trees (an *Alstonia*) which I do not visit as often as the others, for it has not yielded Lycaenids like the others. It is in a shadier part than the others and somewhat inaccessible, but I have had a path cut to it. It is very rich in *Harpagomyia*, but extraordinarily so in the Cecidomyids.

Aug. 25, 1918.—I spent a good part of to-day at one of the ant-trees just making sure of the habits of the Cecidomyids. The web-hangers [*Chaetodiplosis gymnastica*, see below] I feel sure are closely related, though not the same, the chief difference being in the proboscis. I am not sure that I haven't found a second species, or a variety of the first one [*Farquharsonia*], that appears to compete with a *Cremastogaster* (on the *Teratoneura* tree) for the secretions of *Stictococcus.* It does seem a most precarious mode of existence. Without doubt, the first ones sent do take advantage of the ants in the act of inter-regurgitation. I feel confident that the anatomists will agree that the extraordinary mouth-parts are for sucking only.

[Mr. J. E. Collin wrote Feb. 13, 1920: "I believe Farquharson was undoubtedly right in considering that the proboscis of *Farquharsonia* is for sucking and not for biting. The tip of the tongue-like organ is microscopically pubescent and consequently better adapted for sucking up liquids than for piercing. Also I found no trace of maxillae, which I believe are always present in biting or predaceous insects."]

2. *Chaetodiplosis gymnastica Collin, sp. n.* (p. 507).

[The material includes 8 ♂ 34 ♀ hanging from threads in the hollow at the base of the ant-tree *Alstonia,* at Moor Plantation, Aug. 11, 1918. Also taken with them 1 ♀ of a distinct species. See pp. 508–509.]

Aug. 11, 1918.—Near the base [of the ant-tree *Alstonia,*

p. 369] is a large decayed hollow up the inside of which is a considerable portion of the carton nest of the ants. I found that this hollow simply swarms with them. But in addition to these it suddenly struck me that certain curious little flies, which I had often seen before on ant-trees, but neglected to study, might be the Cecidomyids *at rest*. I had often meant to write you about these curious little flies from their habit of resting habitually on a silk web not unlike the webs of some spiders. I have often seen hundreds of them hanging by their fore-legs, rows of them, on such webs, and vaguely thought they specialised in spider-webs as a resting-place. Now, however, I am in doubt as to the origin of the silk threads, and I am seriously wondering whether the flies do not make them themselves. I am not sure that they are the Cecidomyids yet, but if not they are extremely similar, and when disturbed their flight is much the same, except that they quickly come to rest again on their silk threads. The threads do not appear to be traps for other insects. They are too widely separated. The insects at rest remind one of birds on telephone wires except that they hang down. Though I did find a large bug (dead) resting on the threads, I felt sure that it had fallen on to them after death and was too big to slip through between the "lines." I readily caught a lot of them by bringing together a box and its lid held in either hand. A portion of the "web" was included and in a few seconds the little flies had hung themselves up. None of them settled on the side of the tin. Some of them were hanging with one foot on a thread and another on a leg of the nearest neighbour. To-morrow I hope to have a look at them under the microscope to get a view of their proboscis.

B. THE PURSUIT OF LIVING ANTS BY THE EPHYDRID, RHYNCHOPSILOPA APICALIS COLLIN, SP. N. (p. 509).

[Material:—2 ♂ 3 ♀, taken Dec. 25, 1917–Jan. 26, 1918, feeding from the anus of dead *Cremastogaster* ants as described in Proc. Ent. Soc., 1918, pp. xxxv, xxxvi, xl.]

Aug. 25, 1918.—While I was studying these [Cecidomyids], I noticed some of the little "proctophila" and froze on to one in particular for special observation. I am now certain that they actually pursue living ants, smaller workers, pursuing them *from behind*, with apparently the same unpleasant object. They appear to select an ant of reasonable size (not too big) and run after it, never flying after the "victim." Contact between the fly's head and the ant's posterior end is momentary (not the deliberate and prolonged contact as in the case of the dead ants). The fly then decamps (by a short flight) in search of another. The ants appear to resent the attention most seriously, for they usually stopped dead, bent back their heads and abdomens till they all but met, remaining thus for a few seconds before running off with the abdomen in the air. Unless alarmed, *Cremastogaster* usually runs along with the whole body parallel with the surface on which it is travelling. While I repeatedly saw this happen, I could never actually see the fly absorb anything, so swift was the contact and withdrawal, but I think the flies may be definitely classified as Myrmecophilous.

C. NOTES ON THE LIFE-HISTORY OF MILICHIA ARGYRATOIDES, AND THE HABITS OF OTHER MILICHIDAE.

1. *Milichia argyratoides Collin, sp. n.* (p. 510).

[The pill-box in which the ♂ and ♀ specimens referred to below were contained, bears the following: "Ant-flies, Mamu. 10.ix.15." A further note stated: "From Mamu, a village on the edge of a large forest reserve about 20 miles S. from Ibadan. The village called on the map Gambari is practically the same." The flies were bred out on the road.]

Sept. 28, 1915.—I sent also two small Diptera in a pill-box. I hope they arrived safely. They also are associated in the Shagamu district with the Hewitsonias and the ants. I've got a few fly larvae in spirit. They appeared to live on a running wound on the ant-tree. They covered themselves with excreta, and I saw one *Cremastogaster* carrying away some of the stuff from the surface of a larva. More pupated, but none have emerged. It is extremely difficult to look after them on the road. I had several Hewitsonias drowned in their box one day after I'd carried them for several days. We met a very heavy rain storm. Everything got wet, including my camp bed. I do hope the two small flies will be enough for identification.

April 17, 1918.—I have long wondered what the curious little Diptera of 1915 (*Milichia*) were, with their curious larvae. I hope to get back to the same district some day to get some more. I have no doubt but that they are genuinely Myrmecophilous, though they do not live inside the nests. The larvae wander about in the run of the ants, soft, unprotected things, that cover themselves with excreta much like Criocerid larvae. The ants seemed to have a liking for this and fed on it, without at all molesting the larvae. They pupate in queer little cocoon-like things and more or less gregariously.

April 28, 1918.—When he [Mr. H. N. Thompson, Director of Forests] returns I am going for a week-end to one of his forest reserves, where I found the *Milichia* larvae, and can find many other good things too.

2. *Milichia farquharsoni Collin, sp. n.* (p. 514).

[The "haunting flies," referred to below as "absolutely guaranteed," consisted of 5 ♀, evidently captured on or around *Cremastogaster* ants' nests in May, 1918.]

Feb. 4, 1918.—There's a little black and extremely active Dipteron that haunts one of my trees and on it the huge *Cremastogaster* nest the inhabitants of which never seem to rest day or night. These little flies, in quite considerable numbers, alight on the carton of the nest, dodge about among the ants, and are always at it. Yet I've never been able to find out what they are after! A *Cremastogaster* nest is no place to sit down at, till one finds out—it is up a tree as it happens. But I've stood on a ladder till my legs ached without success. They aren't there simply for the fun of the thing I know, but that's all of their ways that I'd care to dogmatise about, and it's not very helpful.

May 28, 1918.—I told you I may possibly have sent Myrmecophilous Diptera whose exact doings I have not yet cleared up, but which haunt the nests of *Cremastogaster* instead of the real mendicants. By this mail I send a small number of absolutely guaranteed mendicants as well as a few of the others, also absolutely guaranteed. I know of still more Diptera closely related to these, and I find that the Cecidomyid occurs here also. I will write fuller notes later.

3. *"Mendicant" Milichidae and Mimetic Ant-flies.*

[The habits of these flies were described by Farquharson in Proc. Ent. Soc., 1918, pp. xxxiii, xxxiv, xl. The specimens sent in illustration and captured between Dec. 23, 1917, and Jan. 26, 1918, included three distinct species (at first only two were recognised, *ibid.*, pp. xxxiii, xl) described by Mr. Collin on pp. 512–14, viz. *Milichia proectes*,—1 ♂; *M. prosaetes*,—1 ♂, 1 ♀; *M.*

dectes,—1 ♀. The "absolutely guaranteed mendicants" referred to above were received July 18, 1918. In mounting the specimens these "mendicants" were kept distinct from the "haunting flies"—*M. farquharsoni*, but the relationship to the notes was inadvertently lost, so that at first it was impossible to determine which group was "haunting" and which "mendicant." They were all carefully labelled (1) and (2) and sent to Mr. Collin, who found in (2) two of the "mendicant" species sent before, while (1) contained only the 5 ♀ of the hitherto unseen species *M. farquharsoni*. It was therefore certain that the latter are the "haunting flies." Group (2) of "absolutely guaranteed mendicants" contained *Milichia prosaetes*,—4 ♀; *M. dectes*,—2 ♂, 3 ♀, all captured, evidently in May, 1918, on *Cremastogaster* ant-trees.

The following extracts show that there are still other, probably undescribed, species of Milichidae to be found associated with *Cremastogaster* in S. Nigeria, together with an "ant-mimic" which cannot be placed with certainty. Mr. Collin wrote, April 17, 1921: "When one remembers that Farquharson found a Cecidomyid and an Ephydrid under circumstances and with habits so completely different from what one would expect in a member of either family, one hesitates to offer an opinion on the identity of the other small fly whose habits he describes."]

April 28, 1918.—I am to look more carefully into the mendicant flies. There are at least two others that share Coccid secretions with the ants, one with the underside of the abdomen a silvery white. They are all associated with the same ants, and I may have sent them by accident mixed with the mendicants. However, I'll get more and so clear up the point. I should say they all belong to closely related genera. I saw the mendicants busy this forenoon.

Aug. 11, 1918.—At the same time [viz. when observing the Cecidomyids] I found some of the little "proctophila" besides another small fly that appears to be an ant-mimic (in spite of its wings). It wanders about among the ants keeping its wings in motion all the while in the manner of Ortalid flies when they settle, and appears to feed on undefined matter on the somewhat moist surface of the hollow tree. They settle among the ants and dodge about with extraordinary freedom.

Aug. 25, 1918.—When I was studying the Cecidomyids to-day I collected some of the mimetic flies of which I told you. They simply dodge amongst the ants and lick up their food, whatever it be, from the surface of the tree-trunk. I can see their proboscis in the act. Viewed at certain angles (when the wings cannot be seen), they are really very like the ants themselves.

D. The Prey of the Asilid Fly Philodicus temerarius Walk. (Asilinae).

[The following table of captures made within a few days, by one species at one place, shows the existence of very comprehensive tastes. The only prey hitherto recorded for *Philodicus* includes but one Lycaenid and one Tachinid (Trans. Ent. Soc., 1906, p. 344). The allied Asilids exhibit a marked preference for Lepidoptera and Orthoptera (*ibid.*, pp. 372, 373). Of the 13 victims here recorded, 5 are Diptera, 3 Orthoptera, 3 Hemiptera, and 2 Homoptera. In identifying them I had the kind help of Dr. Guy Marshall, and, with the Diptera, of Prof. M. Bezzi and Mr. C. G. Lamb.]

Agege: 1917.	*Philodicus temerarius.*	Prey.
Oct. 21	♂	*Tettigoniella cosmopolita* Sign. (Jassidae: Homoptera).
,, ,,	♂	♀ fly, probably of genus *Paralimna* (Ephydridae).
,, ,,	♂	The Capsid bug *Proboscidocoris* sp. A.
,, ,,	♀	♂ fly, probably of genus *Paralimna* (Ephydridae).
,, ,,	♀	♀ Anthomyid fly, *Coenosia* sp.
,, ,,	♀	Immature Acridian, *Acrydium* (*Tettix*) sp.
Oct. 22	♀	The Capsid bug *Proboscidocoris* sp. A.
,, ,,	♀	*Tettigoniella cosmopolita* Sign. (Jassidae: Homoptera).
,, ,,	♀	Immature Acridian, *Acrydium* (*Tettix*) sp.
Oct. 24	♂	The Capsid bug *Proboscidocoris* sp. A. A Gryllid, *Euscirtus* sp., probably new. ♂ fly, probably of genus *Paralimna* (Ephydridae). ♂ Anthomyid fly, *Coenosia* sp. Prey of the 4 *Philodicus*. Individual captors not recorded.
,, ,,	♂	
,, ,,	♀	
Undated.	♂ and ♀ *in cop.*, ♀ with prey.	

E. THE TACHINID FLY BENGALIA ATTACKING TERMITES.

[See Proc. Ent. Soc., 1919, p. lii–lviii and references quoted, for evidence that *Bengalia* seeks Termites because it is unable to penetrate any but very thin-skinned insects or those which have been bitten by ants. See also Trans. Ent. Soc., 1906, pp. 394–396 and references, for the habits of the allied Oriental *Ochromyia jejuna* F.]

Agege.

Oct. 18, 1917.—One little incident of the great *maculatus*-Lycaenid find [p. 392] I might just add while I remember it. When the Termitary was broken up the white ants were of course scattered over the ground, and, in no time, I am sure there were not less than a dozen Bengalias hawking around, to whom the feeble Termites fell an easy prey. At Ibadan some time ago I got one of these enterprising flies in the act of attacking, successfully, a de-alate *Termes bellicosus* the morning after a nuptial flight, and I have even seen them tackle a fair-sized Noctuid larva.

VI. HEMIPTERA.

The Procryptic Appearance and Attitude of certain Hemiptera on an " Ant-tree."

[Unfortunately no specimens were sent and the species cannot be identified. Dr. G. A. K. Marshall thinks it is fairly certain that the species was a Pentatomid, for this family includes several W. African species that frequent tree-trunks and are more or less lichen-like. *Atelocera* is perhaps the most likely genus.]

March 20, 1915.—I found some very curious bugs the other day on a tree here. Perhaps Lamborn sent you them before. The nymphs were resting on the lichen-covered bark of a large tree and looked greatly like a large scale insect; they rested on the surface absolutely motionless, and were so like the lichen that I failed to notice them during a considerable interval during which I was looking at some ants which nest in that particular tree. The ants did not seem to mind them. So perfectly quiet were they that I thought they were large scale insects. Concealed in deep cracks on the bark I found some of the mature bugs, not so well protected as the nymphs by their colour. This protection, in virtue of their power of flight, and their odour when disturbed, the adults would not require, though they were by no means conspicuous. They rested in groups of three or four together.

APPENDIX.

A. NEUROPTERA.

I. *Description of a new Species of Embiidae from Southern Nigeria.* By Prof. F. Silvestri.

Plates IX, X.

Embia (Rhagadochir) apicata, sp. n.

♂. Corpus (exsiccatum) castaneo-nigrescens thorace ochraceo-ferrugineo, antennarum parte distali albicante, alis castaneis lineis intervenalibus albis, pedibus castaneis, cercis castaneis parte distali albicante.

Caput subaeque longius (labro excluso) atque latius (oculis inclusis), lateribus pone oculos gradatim parum convergentibus, angulis posticis rotundatis, superficie setis brevioribus et brevissimis vestita. Oculi reniformes, aliquantum prominentes. Antennae 24-articulatae attenuatae, articulo primo subcylindraceo quam ceteri aliquantum latiore, articulo tertio c. 1/3 longiore quam latiore et quam secundus etiam c. 1/3 longiore, articulo quarto secundo longitudine subaequali, articulo decimo parum minus quam dimidium longiore quam latiore, articulis omnibus setis numerosis subtilibus sat longis instructis. Mandibulae apice bidentato instructae.

Pronotum postice parum latius quam longius, lateribus partem anticam versus aliquantum convergentibus, setis numerosis brevibus instructum; mesonotum margine antico setis longis antrorsum nec non setis numerosis medianis subanticis instructum; metanotum nudum scuti margine postico subrecto. Alae venis *vide* Pl. IX, 1–3.

Pedes setosi, primi paris tarsi articulo primo, subtus menso, parum magis quam duplo longiore quam latiore, tertii paris coxa, lateraliter mensa, duplo longiore quam latiore, secundi et tertii paris tarso *vide* Pl. IX, 5, 6. Abdomen setosum segmenti ultimi forma et cerci *vide* Pl. IX, 7, 8.

Long. corp. cum alis mm. 12·5, sine alis 10·5, lat. capitis (cum oculis) 1·60, pronoti partis posticae 1·30, mesonoti 1·56, long. antenn. 6·5, alae anticae 10·3, lat. ejusdem 3, long. ped. paris tertii 5.

♀. Corpus nigrescens prothorace testaceo-ochraceo, antennis parte distali albicante, pedibus nigrescentibus, coxis, trochanteribus testaceo-ochraceis, tibiarum basi et secundi et tertii paris tarsis aliquantum rufescentibus.

Caput subellipticum, paullum longius quam latius, lateribus late convexis, oculis vix prominentibus. Antennae in exemplo typico haud integrae, articulo tertio quam secundus vix longiore, articulo decimo vix longiore quam latiore. Mandibulae (Pl. X, 5) apice unidentato, parte molari transverse profunde sulcata.

Thorax pronoto subtrapezoideo, mesonoti scuto quam idem metanoti parum longiore et paullum angustiore.

Pedes primi paris tarsi articulo primo, subtus menso, parum magis quam duplo longiore quam latiore, paris tertii femore, lateraliter menso, parum magis quam 1/3 longiore quam latiore, secundi et tertii paris tarsi *vide* Pl. X, 1–3.

Abdomen a segmento septimo parum, a segmento octavo aliquantum angustius, tergiti decimi margine postico rotundato, cercis *vide* Pl. X, 4.

Long. corp. mm. 14, lat. capitis 2·2, pronoti partis posticae 1·60, mesonoti 2, long. pedum paris tertii 5·6.

[Two ♂ and 2 ♀ from webs on Pará Rubber trees at Agege, near Lagos: 1917–1918. For notes on the webs and enclosed Embias see pp. 413–16.—E.B.P.]

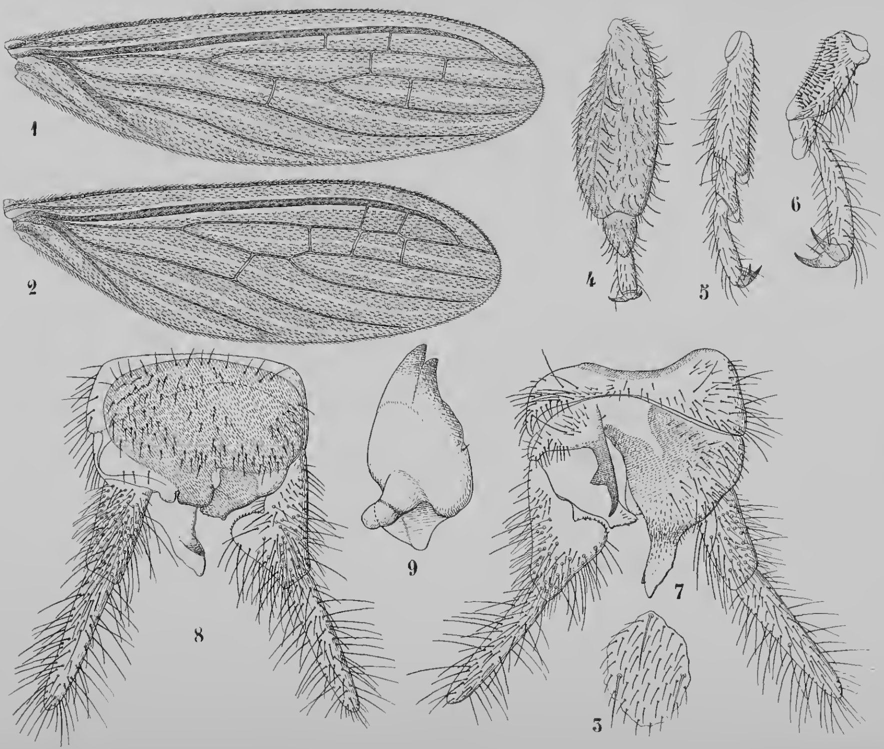
Larva. Corpus totum testaceum. Antennae 15–19-articulatae, articulo tertio quam secundus aliquantum longiore.

Long. corp. mm. 7; lat. capitis 0·92.

[These larvae were from the cotton-seed sacks at Moor Plantation (pp. 415–16). Prof. Silvestri wrote concerning them, Jan. 12, 1921: "It is very probable that these larvae belong to the same species as the ♂ and ♀, but one cannot be absolutely certain if they were not collected near the adults. The web and the environment of the larva may be rather different from those of the adults."—E.B.P.]

Observatio. Species haec ad *Embia* (*Rhagadochir*) *vosseleri* End. proxima est, sed colore et maris partis laevae tergiti decimi forma saltem distincta est.

Trans. Ent. Soc. Lond., 1921, Plate IX.



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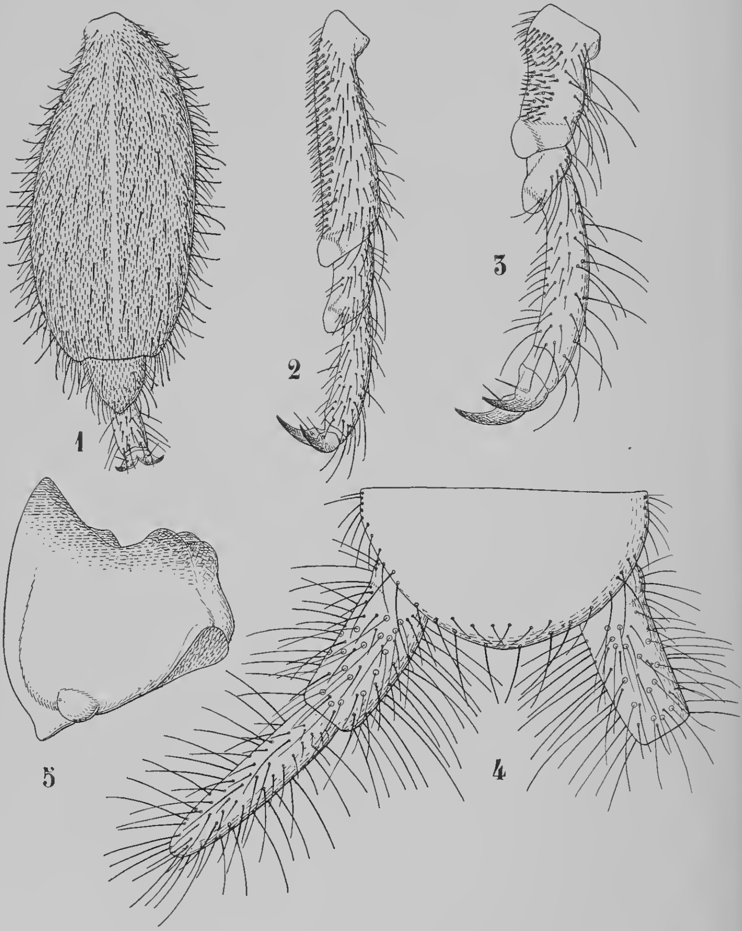
EMBIA (RHAGADOCHIR) APICATA Silvestri (male)



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EMBIA (RHAGADOCHIR) APICATA Silvestri (female).

EXPLANATION OF PLATE IX.

Embia (*Rhagadochir*) *apicata*, mas: 1, ala antica; 2, ala postica; 3, alae particula, multo ampliata; 4–6, pedum primi, secundi et tertii paris tarsus et praetarsus; 7, corporis pars posterior a segmento nono prona; 8, eadem supina; 9, mandibula dextera supina.

EXPLANATION OF PLATE X.

Embia (*Rhagadochir*) *apicata*, femina: 1–3, pedum primi, secundi et tertii paris tarsus et praetarsus; 4, corporis pars posterior a segmento decimo; 5, mandibula dextera supina.

II. *Corrodentia: Psocidae. On a new Southern Nigerian Psocid.* By Prof. R. Newstead, F.R.S.

Plate XI. Text Figure 1.

Psocus nigeriensis, sp. n.

General colour of body dusky ochraceous, legs slightly paler than thorax with the distal extremities of the tibiae dark brown or black; spines on the legs dark brown or black; nasus sometimes with very faint traces of dark brown, interrupted, vertical markings. Antennae with the first three segments slightly paler than the thorax, the rest dark brown or blackish. Wings with the venation normal, perostigma very faintly infuscated; there is also a small faintly infuscated area immediately below the superior apical furcation; the transverse vein and the proximal branches of the forked vein (forming roughly the cursive numeral 4, upside down on the left and also retrograde on the right), also the veins enclosing the marginal cellules 2–4, and the major portion of the superior apical furcation, intense dark brown to blackish; the remaining portions of the veins faintly indicated and almost colourless. Eyes either partially or entirely black.

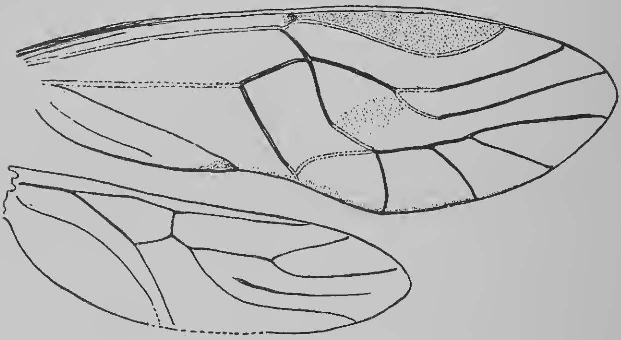

Fig. 1. *Psocus nigeriensis*, Newstead.

♀. Number of antennal segments doubtful (ten were counted in one individual, but this appeared to be imperfect); 1st and 2nd segments very short and the former moniliform and much stouter than the 2nd; 3rd and 4th equal in length, and about ten times longer than the 2nd. Maxillary palpi (Pl. XI, *a*) with the 2nd segment nearly equal in length to the 4th, all the segments with fine stiff hairs. The long, "slender, curved, horny process" (Westwood) or maxillary fork normal (Pl. XI, *b*). Mandibles (Pl. XI, *c*) asymmetrical, tridentate distally, inner surface, at the base, with a large and somewhat quadrate tooth-plate or rasp-like structure composed of 16 rows of minute teeth (Pl. XI, *c*1); immediately above this on the inner margin of the right mandible is a small blunt tooth. Lingua (Pl. XI, *d*) composed of two broad, blade-like processes the edges of which are folded over and finely but bluntly serrate, the two structures fused in the middle line so that collectively they form a trough-like process. Pharynx or pharyngeal sclerite strongly chitinised and leading from this is a strongly defined chitinous chord or "lingual duct" (Pl. XI, *d*1) which bifurcates just beyond the middle distance, one branch going to each of the two blade-like structures ("lingual glands") respectively, each one terminating at the anterior margin where they are apparently connected with a small opening or channel. Tibiae of all the legs thickly clothed with long, stiff spines (Pl. XI, *e*) each of which is partly surrounded, at the base, by a minute coronet of short stiff spines; tarsi of two segments, those of legs ii and iii (Pl. XI, *e*1) with a closely packed series of long stout curved spines, each surrounded by a coronet of short spines ("ctenidiobothrien"), similar to, but much larger than, those on the tibiae; on the proximal segment of leg ii there are 13 and on the distal one 3; on leg iii there are 24 and 6 respectively. Abdomen very sparsely clothed with minute hairs; distal segments (Pl. XI, *f*) with the sclerite of the 9th abdominal sternite of three processes, the median one more or less pointed, the laterals (Pl. XI, *f*2) quadrate with the distal margin furnished with small bluntly pointed spines; terminal segment with two pairs of spine-like processes (Pl. XI, *f*1) the lower pair much the larger.

Length of specimen restored in KOH, 3·5 mm.

Length of fore-wing, 6·3 mm.; total expanse of wings, 14 mm. approximately.

♂. Abdominal hairs longer and more numerous than in the ♀. Genital armature of the only example before me, has not restored sufficiently in the KOH to enable me to determine the morphological characters with any degree of exactness. I can only add that the lateral lobe-like extensions are rather thickly studded with very long hairs (Pl. XI, *g*) each of which is surrounded by a rosette-like pattern.

WEST AFRICA: Agege, S. Nigeria, gregarious on the bark of Pará Rubber (*Hevea brasiliensis* Müll. Arg.);

22.ix.17. See pp. 418–20 for an account of the habits of this and two other species.

This somewhat remarkable species is nearly allied to *Psocus kiboschoënsis* Enderlein;* but the fore-wings are much longer and the structural characters of the pygidium of the female, together with the greater number of "ctenidiobothrien" on the tarsi, readily distinguish it.

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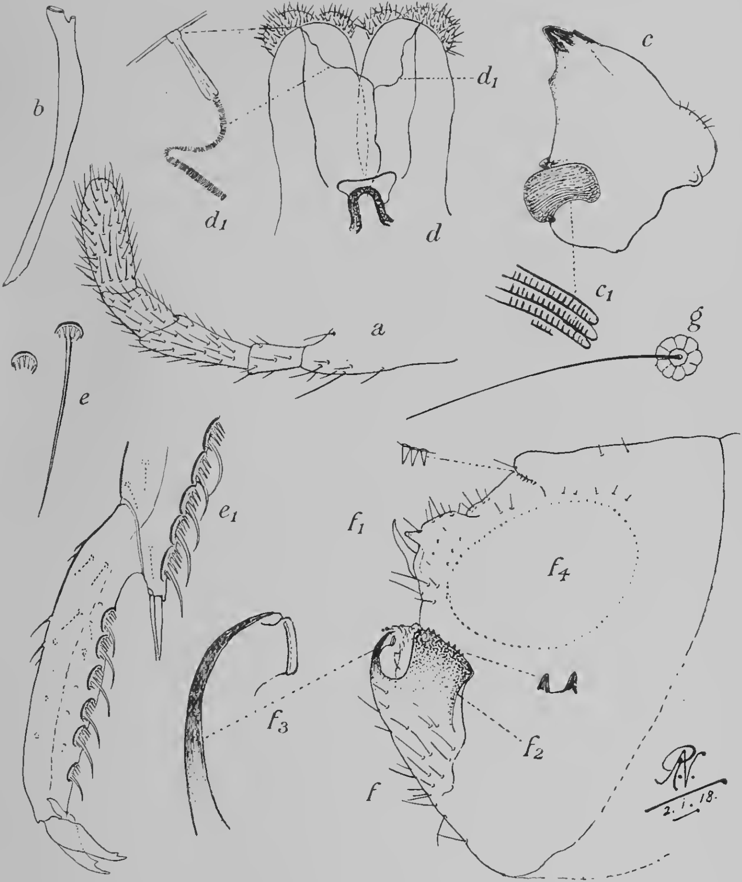
* Der Schwedischen Zool. Exp. Kilimanjaro-Meru; 3B, p. 31, taf. 5, figs. 2, 8 (1910).

EXPLANATION OF PLATE XI.

Psocus nigeriensis Newst. ♀: *a*, maxillary palpus; *b*, maxillary process; *c*, mandible; *c*1, compound tooth-plate; *d*, lingua; *d*1, chitinous chord; *e*, compound spines (ctenidiobothrien); *e*1, tarsus with the ventral compound spines; *f*, pygidium in profile; *f*1, spine-like processes; *f*2, one of the quadrate sclerites; *f*3, median sclerite; *f*4, the dotted ovate line indicates the position of one of the faecal pellets. *g*, ♂: rosette-like platelette and hair on the anal lobes.



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PSOCUS NIGERIENSIS Newstead.

B. HYMENOPTERA.

III. *On a new Joppine* (*Ichneumonidae*) *Genus and Species bred from a Lycaenid Larva in Southern Nigeria.*

By James Waterston, B.D., D.Sc., Assistant in the Department of Entomology, British Museum, Natural History.

Text Figures 2, 3.

The single Ichneumonid in Mr. Farquharson's collection, though represented by only one example with defective antennae, has proved to be of great interest. A prolonged study of this specimen convinced me that it must be assigned to the Joppinae, and further that it was referable to no described genus. At my request Dr. A. Roman of Stockholm examined the insect, and his opinion as to its systematic position agrees with that just expressed. For this kindness and further for drawing my attention to the importance of the host attachment (*vide infra*) of this new genus I desire to express my hearty thanks.

The genus *Adelotropis* (ἄδηλος, τρόπις) is easily recognised by antennal and neurational characters and the genotype in all probability by colour and puncturation.

Fam. ICHNEUMONIDAE.
Sub-fam. Joppinae.

Adelotropis, gen. nov.

Head as wide as thorax. Frons smooth, without carina between the antennae. Face medianly raised, the swelling defined with moderate sharpness just below the toruli and fading out towards the clypeus. The latter not separated from the face medianly but shallowly at the sides (towards the ends of the tentorial apodemes). Inner orbits a little divergent towards the mouth edge. Occiput and genae smooth. The latter slightly swollen posteriorly so that in profile the genae are not margined. The occipital margin, fine but distinct and thinning out ventrally, reaches the mouth edge as a delicate line perceptible only from behind. The first normal funicular joint (post annellus) shorter than the second which is longer also than its successors. Thorax robust; notauli shallow and indistinct; scutellum deeply separated from scutum and bluntly, conically, elevated with a broad raised flange which is apically defective. Propodeon dorsally short, deeply separated from postscutellum, its areae almost completely but in places indistinctly indicated. Spiracles rather narrow. Wings. The outermost (3rd) abscissa of the radius is straight and the 2nd recurrent broken just below ½ and with a rudimentary external branch. In the hind-wings the nervellus is very slightly antefurcal and broken at its lower extremity. The discoidella emitted here and the posterior beyond this point are spurious.

Abdomen, 2nd segment with pronounced punctate striate sculpture; gastrocoeli large. Hind-legs, especially the femora, robust, tarsal ungues strong, simple.

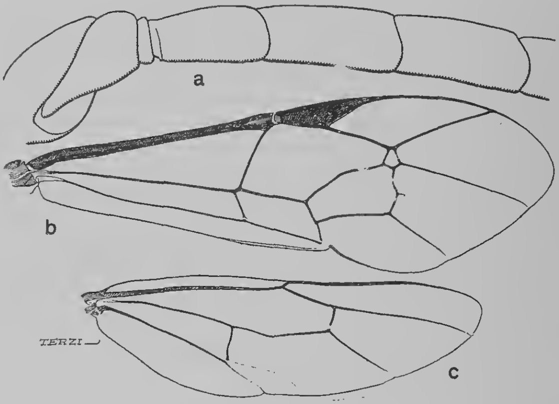

Fig. 2. *Adelotropis farquharsoni*, sp. n., (*a*) Basal joints of antenna, (*b*, *c*) Wings.

In its genal characters this genus closely resembles *Joppa* F., but its affinities on the whole are with the genera *Anisobas* Wesm., *Listrodromus* Wesm., and *Neotypus* Först., particularly with the latter. A further indication of the relationship of these four groups is to be found in their host attachment—all of them parasitising Lycaenids.

Genotype the following.

Adelotropis farquharsoni, sp. n.

♀. Head and antennae, up to the 8th normal funicular joint, blackish brown except for one large pale spot at the base of the mandible, a second along the inner orbit of the eye extending upwards to the level of the anterior ocellus and inwardly to the edge of the torulus and a third narrow and indistinct along the posterior orbit on its upper $\frac{1}{3}$. Thorax dark ferruginous, propodeon more infuscated especially antero-dorsally. Legs and abdomen blackish brown, the fore and hind tarsi slightly paler. Apex of hind coxae and hind tibial spurs pale. The abdominal tergites from 4 onwards broadly yellowish white apically, as is also the upper half of the sheath of the terebra.

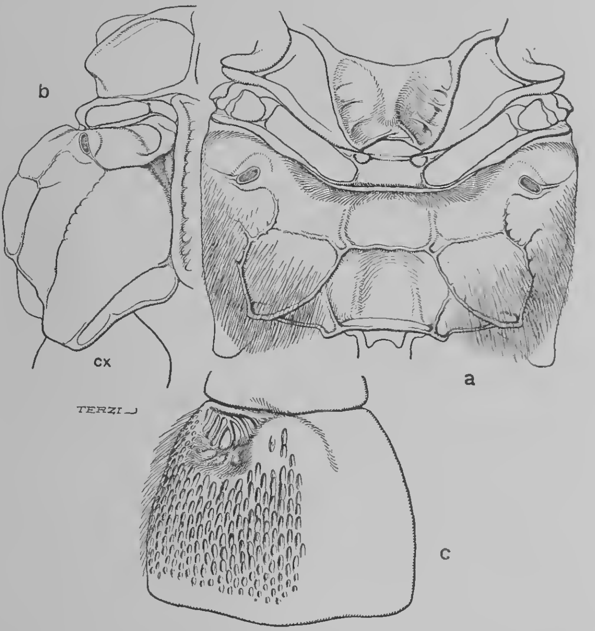

Fig. 3. *Adelotropis farquharsoni,* sp. n. (*a*) Propodeon from above, (*b*) Propodeon in profile, to show the areae. The punctuation is not expressed. (*c*) Post petiole and succeeding tergite, to show puncturation of the latter. (*cx*) Coxa.

Head, occiput to genae shining with only a few scattered punctures behind the ocelli; vertex with a few punctures (minute) anteriorly at the sides of the ocellar triangle. Frons smooth and finely and sparsely punctate at the sides on the pale spots. Face and clypeus dull, closely and finely punctate.

Thorax. Mesonotum (including scutellum) with rather large coarse sparse but even puncturation. Mesosternopleurae more closely punctate; upper part of furrow smooth: posteriorly before the epimeron, it is crenulate. Metapleurae deeply sunk. Propodeon. With care all the areae can be made out but the best-defined keels are those bounding the dentiparal area which postero-laterally bears a low inconspicuous tooth best seen from above (fig. 3*a*). Fairly distinct too are the keels above and below the pleural area (fig. 3*b*).

Basal area and areola confluent and nearly merged with the external areae. The dorsal surface of the propodeon within these areae shining and smooth but irregular, such punctures as are present being near the sides of the areae. Juxta-coxal, pleural, spiracular and posterior areae dull, with coarse close puncturation. Particularly at the sides and posteriorly (*i. e.* over the punctured surfaces) the propodeon is clothed with a dense whitish pubescence.

Wings (see fig. 2*bc*). About 10 hooks on the costa of the hind-wings.

Legs. Hind coxae externally coarsely and closely, the hind femora more finely, punctured.

Abdomen. Petiole smooth shining expanding distally to the wide post petiole. The latter intumescent between and round the small broadly oval spiracles. On the petiole itself are a few elongate punctures deeper anteriorly than posteriorly: apically the punctures become more numerous and coarser especially beyond the spiracles at the sides.

The 2nd (3rd) segment (fig. 3*c*) has a deep coarse puncturation, the punctures for the most part drawn out and deeper anteriorly so that the surface has a sub-aciculate appearance. The 3rd (4th) tergite is similar to the second and also basally crenulate. The remainder of the dorsal surface is smooth.

Length, about 8 mm.

Alar expanse, about 14 mm.

One ♀ bred March 22, 1917, from the larva of a Lycaenid, probably *Deudorix diyllus* Hew., feeding on the flowers of *Pterocarpus esculenta*, at Moor Plantation, near Ibadan, S. Nigeria (p. 382).

IV. *On Chalcid Parasites bred from Pupae of Teratoneura isabellae.* By JAMES WATERSTON, B.D., D.Sc.

[IN a letter of Oct. 18, 1917, Farquharson spoke of sending "two *Teratoneura* pupae from which Chalcids of two kinds emerged. I have more in reserve." (See also his notes on pp. 346–47.) Of the pupae sent, one, A, had yielded, on March 5, 1917, 245 minute Chalcids; from the other, B, found Feb. 21, 1917; a single large female, identified by Dr. J. Waterston as *Chalcis ? leighi*, emerged March 2. The material in reserve arrived later and consisted of 152 minute Chalcids, which emerged Feb. 20, 1917, from a pupa, C, which was not received. These 152 examples were larger than those from pupa A, but considered by Dr. Waterston to belong to the same species *Tetrastichus balteatus.* That the 245 should be smaller than the 152 was to be expected, but that the proportion of males in the larger number should be so much higher (2 to 5 as against 2 to 17) suggests further inquiries which may lead to conclusions of much interest. Dr. Waterston has kindly written (Sept. 18, 1919, and Feb. 29, 1920) the following account.—E.B.P.]

re *Chalcids from* TERATONEURA.

There are in this material two species :—

(*a*) *Eulophidae*—Genus *Tetrastichus.*

Tetrastichus balteatus Waterst. (Bull. Ent. Res. VI, Pt. III, Dec. 1915, p. 241, figs. 4, 6).

Of this species there are [altogether from pupae A and C] 86 ♂ and 311 ♀ (*i. e.* 21·66 % of the total—397) which agree well with the type material bred from the pupa of a Lymantriid moth, Port Herald, Nyasaland. There are some slight differences in the proportion of the funicular joints (♂) which do not appear to be of specific value.

I cannot discover that more than one species is represented. The difference in size which struck you is partly sexual, the female being on the average considerably larger than the male, partly also I believe a matter of nutrition. Sorting the material roughly by size there are two lots of larger and smaller examples respectively. These lots analyse as follows :—

	Mounts.	♂	♀	
Larger examples .	12 " C "	16	136	*i. e.* 2 ♂ to 17 ♀
Smaller examples .	12 " A "	70	175	*i. e.* 2 ♂ to 5 ♀
TOTALS . . .		86	311	

I take it that " C " and " A " refer to separate pupae of *Teratoneura.* If so the difference in size is apparently due to the fact that in the A lot not only was the parasitism heavier but the ratio of males to females over three times higher.

(*b*) *Chalcididae*—Genus *Chalcis.*

Chalcis ? leighi Cam. (Ann. S. Afr. Mus., vol. v, 1907, p. 210). One ♀ from pupa B.

Cameron's species rests on the unique and imperfect type in the B. M., and a complete comparison has not been possible. In your example the puncturation of the hind femora is hardly so heavy, nor is the base of the hind tibia so pale above as in the Natal insect. But the two are extremely close if not identical, as I incline to think they will prove to be.

C. LEPIDOPTERA.

V. *Description of new Species of Lepidoptera, chiefly Lycaenidae from Southern Nigeria, and one from Damba Island, Victoria Nyanza.* By G. T. BETHUNE-BAKER.

a. LIPTENINAE.

Epitola lamborni, sp. n.

♀. Primaries, upperside, costa broadly dark ash-grey, termen broader and darker grey, cell and basal three-quarters of fold covered with very pale blue scales over a whitish ground which shows through as a white spot beyond the end of the cell and as three or four larger spots in the postmedian area; there is a blackish blotch beyond the lower angle of the cell and another at the upper angle; these are more narrowly confluent between veins 4 and 5. Secondaries pale ash-grey with the basal and median areas between veins 1 and 6 covered with very pale blue scales. Fringes whitish with the veins darkly intersecting.

Underside, both wings white with grey markings. Primaries with three spots in the cell, a grey area all round the cell with a good deal of white scaling over it, this grey area is projected right outwards between veins 3 and 4 but recedes somewhat basewards, above vein 4 it recedes and is sharply crenulate, a very irregular white area follows and is succeeded by two rows of very pale grey crenulate markings obsolescing towards the tornus. Secondaries with a basal grey dash, two sub-basal grey spots across the cell, beyond which is a series of about 5 confluent spots across the middle of the cell which is closed by a narrowish dash with a whitish centre, most of the spots have also more or less whitish centres; beyond the cell a very irregular crenulate area of grey and whitish, an irregular broadish clear whitish area follows and is succeeded by two submarginal crenulate grey lines with whitish filling between; termen finely grey.

Expanse 40 mm.

Hab. Moor Plantation, near Ibadan, S. Nigeria.

Type in the Oxford Museum.

I name this after the wonderfully assiduous and able naturalist who bred it on Oct. 29, 1913, from a pupa found two days earlier.

Epitola carpenteri, sp. n.

♂. Upperside, both wings dark brown with the basal and median areas quite covered with somewhat lustrous darkish blue scales which extend almost to the termen in the secondaries. Underside, primaries brown with the median area dark grey and in the postmedian area there is a well-defined paler area crenulate at its inner margin in the fold, whilst beyond the cell is a trace of two small paler spots which are separated from those on the fold by a dash of the dark ground-colour. Secondaries uniformly brown.

♀. Upperside, primaries dark brown, below the cell whitish with a slight superimposition of very pale blue scales, a largish white spot between veins 2 and 3 in the postmedian area, and an oblique series of small white spots in the same area just below the costa. Secondaries pale grey with bluish scaling in the basal and median areas. Underside with the bluish and white areas and spots repeated in white, the postmedian spots being separated by a broad dash of the blackish ground-colour about vein 4, otherwise like the male.

Expanse ♂ 38, ♀ 34 mm.

Hab. Damba Island, N.W. Victoria Nyanza, about 20 miles S.E. of Entebbe: ♂—jungle, E. side of island, between Sept. 1 and 15, 1911: ♀—on shore, E. side, July 14, 1911. Mar. 16–May 31 was much the wettest part of Dr. Carpenter's visit, from Mar. 16 to Dec. 22.

Types in the Oxford Museum.

I name this species after its captor. At first I was almost inclined to consider it was a form of *E. cephena* Hew., but further comparison makes me feel it cannot be so.

b. LYCAENINAE.

Epamera farquharsoni, sp. n.

♂. Upperside, both wings lustrous bright azure blue. Primaries with the blue area rounded off so as to leave the upper end of the cell black and not extending into the tornus, it thus leaves the tornus and the apical half of the wing deep black. Secondaries entirely blue except the costa which is grey from vein 6, a large shiny leaden grey roundish sexual patch occupies the cell and somewhat around it. The apex of the wing is narrowly black with a linear black termen. The two tails are black tipped with white whilst the lower longer one is fringed with white as well. Underside, both wings pure white. Primaries with a trace of a straightish very fine grey postmedian line to vein 2, a very large patch of black sex hairs from the inner marginal lobe. Secondaries with a fine distinct dark grey postmedian line, consisting of curved internervular dashes more or less confluent below vein 2 angled and receding to the inner margin, a yellowish submarginal line, a black spot in orange between veins 2 and 3, and another spot on the anal lobe surrounded with carmine and with broad red internal edging and also with a trace of mauve metallic scaling.

♀. Upperside, primaries with the black area smaller in proportion and the blue area much less brilliant and paler fading into whitish at its outer margin. Secondaries with the blue as in the primaries not lustrous and much paler, and with three small marginal anal black spots with orange internal edging. Underside, both wings as in the male but the markings more definite.

Expanse ♂ 38, ♀ 42 mm.

Hab. Moor Plantation, near Ibadan, S. Nigeria.

Types in the Oxford Museum, 2 ♂ 7 ♀. All were bred from larvae feeding on flowers of *Loranthus incanus* parasitic on *Funtumia elastica* (see pp. 362–63).

Deudorix odana H. H. Druce.

♀. Upperside, both wings dull lavender grey with broad dusky external margins. Underside, just like the male but whiter.

Expanse 44–46 mm.

Two examples, bred by Farquharson at Moor Plantation.

There appear to be two forms of this species in both sexes. In the Farquharson specimens the undersides are white, the females even whiter than the males. On the upperside the Farquharson females are grey. In my own collection the under surface of the male is dark grey, whilst my two females are uniformly brown above and pale stone-grey beneath, the pattern in both cases being typical. My specimens are from Sierra Leone and the Cameroons.

[After hearing of the above-described variation in colour, I sent two of the most divergent of Lamborn's males from Oni to Mr. Bethune-Baker, who compared the armatures with those of his own forms and found all precisely the same.—E.B.P.]

I have been unable to find any record of a description of the females of this and the two following species, and as there are specimens of all, bred with their males by Farquharson at Moor Plantation, near Ibadan, S. Nigeria (see pp. 378, 381), it is well to make the record.

Deudorix (Pilodeudorix) diyllus Hew.

♀. Upperside, both wings uniform dark brown with pale grey fringes. Underside, stone grey with the markings narrow exactly like the male.

Expanse 31–34 mm.

Deudorix (Pilodeudorix) camerona Plötz.

♀. Upperside, both wings dark brown with the basal half having a somewhat leaden tinge. Underside, pale brownish (not the cold leaden grey of the male) with all the markings precisely as in the male but slightly larger. Fringes darkish grey.

Expanse 35–38 mm.

c. HETEROCERA : LITHOSIINAE.

Chionaema farquharsoni sp. n.

♀. Upperside, white. Primaries with a sub-basal curved scarlet stripe, median scarlet stripe slightly curved, postmedian stripe very slightly angled below the second black spot and from there inclined outwards; termen scarlet broadish in the apical area, two black spots, the first in the cell, beyond the middle, and the second at the end of the cell.

Expanse 25 mm.

Type in the Oxford Museum, a female bred 1916–17 from a cocoon found on the *Cremastogaster* ant-tree, *Alstonia congensis*, at Moor Plantation.

This appears to be near *Chionaema pretoriae* Distant. The cocoon is ovate in shape, and is entirely covered, hedgehog fashion, with a dense clothing of fine long hairs which are pennate, consisting of a main quill from which emanates on each side a series of fine hairs (see also p. 488).

VI. *Notes on two Lipteninae collected by C. O. Farquharson.* By Prof. E. B. POULTON, F.R.S.

a. THE MIMETIC PATTERN OF TERATONEURA.

At the time when the first specimen (p. 339) was received, the only example that I knew of in any collection was the male type of *isabellae* Dudgeon, in the British Museum. The arrival of the female made possible the full consideration of the probable bionomic significance of the pattern. The upper surface is clearly mimetic of the male *Planema epaea* Cram., which is the primary model of several other species. The female *Teratoneura*—having somewhat smaller, less reddish, paler orange markings, with comparatively dyslegnic borders—is a better mimic than the male. In addition to the mimicry of the male *epaea*, this Lycaenid appears also to exhibit secondary resemblance to certain other species of *Lipteninae*—to the female of *Telipna acraea* Westw., the male of *Mimacraea fulvaria* Auriv., both male and female *M. dubitata* H. H. Druce, and more distantly to the male of *M. apicalis* Sm. and Kirb., with a pale subapical bar to the fore-wing.

Farquharson wrote on Feb. 28, 1917, concerning the mimicry of *Teratoneura*: "Although the upper-surface colours are rather Acraeine-like, I have not observed any Acraeines near the tree nor any of those whose flight is anything like as rapid as that of the Lycaenid. When at rest the wings are folded and the lower wings take up rather a curious position so that their tips project above the line of the anterior pair. The poise is on the whole rather Skipper-like."

Although it is usual for models and mimics to frequent the same type of country and to be found flying together, examples of forest species mimicking those of more open country are well known. The flight of a mimicking species is commonly more rapid than that of its model.

b. THE SYNONYMY OF CITRINOPHILA TENERA KIRBY. THE PATTERNS OF THE SEXES DIFFER AS DO THOSE OF THE MODEL, TERIAS. J. RÖBER'S RECENT CRITICISMS.

As there is a fine series of 31 males and 14 females of this form at Oxford, nearly all captured at Oni by Mr. W. A. Lamborn, it seemed advisable to take this opportunity of clearing up the synonymy. By the kindness of Mr. J. J. Joicey I have been permitted to study the four Kirby types in the Grose-Smith collection—*limbata* and *marginalis*, both males, from the Cameroons, *tenera* and *similis*, both females, from Gaboon and Ashanti, respectively. Aurivillius ("Rhop. Aethiop.," p. 269), considers *limbata* a synonym of *tenera*, and *marginalis* of *similis*, which also " = ? *tenera*." Dr. Eltringham and I entirely agreed with this last suggestion which would sink the other three names to *tenera*. We had not the slightest doubt that all four are conspecific and only differ in variable features of the pattern. In fact so far as the male types are concerned there was no difference at all worth mentioning, both types coming from the same locality, *marginalis* being slightly the larger and paler of the two, the latter distinction apparently due to its being a little more worn. The two female types differ in a variable feature—the black margin of the hind-wing upper surface—that of *tenera* being narrow and interrupted, forming a beaded *Mylothris*-like border, the beads developed at the ends of the veins, the interruptions internervular. The under surface of both wings is similarly beaded, but this is a common feature in all forms of the species. The name *similis* may be conveniently retained for female forms of *tenera* with the black margin of the hind-wing upper surface continuous and not beaded. This form is evidently much commoner than the type, and 13 out of the 14 Oni females belong to it, the 14th, with its black margin reduced to scattered dots but not beaded, being transitional to the *tenera* ♀ form. The whole of the 31 males are fresh, bright specimens, precisely like the type of *limbata* except for the absence in the latter of a small central black spot on the hind-wing under surface. In fact, the Oxford series entirely supports Aurivillius' conclusions. There is no doubt that the four types of Kirby are a single species, and that all the Oni males are *limbata* (a synonym of *tenera*), while all the females but one are the *similis* ♀ form of *tenera*, the exception approaching the *tenera* ♀ form.

When a long series of males and females of *Citrinophila tenera* are compared together certain extremely interesting differences are revealed. In the females the orange ground-colour is paler and yellower, the black margin of the fore-wing upper surface does not extend along the basal section of the costa (noted by Eltringham in "African Mimetic

Butterflies," Oxford, 1910, p. 89), and the black margin of the hind-wing upper surface is narrower. In other words the differences are those commonly characteristic of the genus *Terias*, viz. of the Pierine models.

J. Röber in an article on mimicry (Entom. Mitteilungen, vol. x, nr. 1, Jan. 5, 1921, p. 23) disputes Doflein's conclusion (Hesse and Doflein "Tierbau und Tierleben," vol. ii, 1914, pl. ix) that *Terias* is the model of *Citrinophila*, because the special protection of *Terias* has not yet been proved, and because of the difference in size. But such a difference between model and mimic is common and unimportant; for, as Mr. F. A. Heron has pointed out, apparent size is determined by distance (Proc. Ent. Soc., 1903, pp. lxv, lxvi). Furthermore, the resemblance deceives the insects themselves; for one of the Oni males referred to on p. 465 was observed by Lamborn, on Aug. 5, 1910, to be eagerly pursuing a male of *Terias senegalensis* Boisd., and both were taken in a single sweep of the net. Although this *Terias* is not so good a model as *brigitta* the two insects would closely resemble each other on the wing. The correspondence between the patterns of the sexes referred to above supplies further evidence of mimetic association.

I have now had the opportunity of studying Doflein's plate, and find that the figures of *Citrinophila similis* and its model *Terias brigitta* Cram. are copied from Dr. Eltringham's work, published in 1910 (*ibid.*, p. 89, pl. ix. figs. 27 and 22, respectively).

Dr. Dixey has kindly written the following note on the mimicry of *Citrinophila tenera* :—

"Of the three common species of *Terias* which occur in the same locality as Mr. Lamborn's specimens of *Citrinophila tenera*, viz. *T. brigitta* Cram., *T. regularis* Butl., and *T. senegalensis* Boisd., the resemblance is closest to *T. brigitta*. The correspondence between the male Lycaenid and the male Pierid is remarkably exact; that between the respective females is also quite good, but in this latter case there are some interesting differences. The aspect of *T. brigitta* ♀ varies according to season, and the aspect of *C. tenera*, ♀ f. *similis* presents features which belong to the wet phase of *T. brigitta* ♀ together with some that are characteristic of the dry. The dark border to the hind-wing in the *similis* ♀ suggests the 'wet-season' phase of *T. brigitta* ♀, while the uniform yellow of the ground-colour, and absence of dusky irroration, are marks of the 'dry-season' phase. The *tenera* ♀ on the other hand, with a greatly reduced hind-wing border, resembles the dry phase of the model in this as in the other respects. It appears, however, to be far less common than *similis*, at any rate in the Lagos district.

"It may perhaps be said that on a rapid glance an average *similis* ♀ of *C. tenera* would pass muster as either a 'dry' or a 'wet' *T. brigitta* ♀. The yellow of the female *Terias* is usually paler than that of the male at all seasons, and the yellow of the female Lycaenid tends similarly to be paler than that of the male, but to a less extent. The absence of the dark costal border to the fore-wing, passing inward from the dark apex, is characteristic of the female of both species. The yellow of *Citrinophila*, being slightly tinged with ochre, is hardly so brilliant as that of *Terias*, but there can be little doubt that it would be difficult to distinguish the two insects when flying, or even when settled.

"The upper surface of the yellow examples of the larger species of *Citrinophila* (*C. erastus* Hew., or probably a closely allied species or subspecies), captured by Lamborn at Oni, differs in size and shape and to some extent in colour from *C. tenera*. In all these respects it approaches the aspect of *Terias regularis* Butl., a near ally of *T. brigitta*. The under surface of this *Citrinophila* resembles, strongly in the female but less so in the male, a pattern common in the Pierine genus *Mylothris;* and the same is true of the upper surface as well as the under of the creamy white female of typical *erastus*, although the yellow upper surface of its male is mimetic of *Terias*. The resemblance of the white female to *Mylothris* was described by Eltringham in 1910 (*ibid.*, p. 90, pl. ix, fig. 30). See also Proc. Roy. Soc., B., vol. 91, 1920, pp. xxiv, xxv.

"The general resemblance of *Citrinophila* to *Terias* extends also to *T. senegalensis*, but is much less obvious in this case than in the other two.

"It is worthy of note that *Liptena flavicans* Sm. and Kirb., specimens of which are also in Mr. Lamborn's collection from Oni, at once recalls the dry-season female of *Terias brigitta*, though the brownish-ochreous hue of the former insect is dull in comparison with the clear yellow of the latter."

VII. *The polymorphic Females of Cymothoe theobene Dbl.-Hew. The Specimens captured, and Families bred from known Female Parents by W. A. Lamborn.* By Prof. Poulton.

It is exceedingly interesting that Farquharson should have repeated at Moor Plantation in 1915 the breeding experiments conducted by Lamborn at Oni, 70 miles E. of Lagos, in 1912. No account of these results or of Lamborn's captured specimens has hitherto appeared, and, inasmuch as they add another and very striking example to the list of butterflies with polymorphic females, I take this opportunity of describing them. The new female forms, which are very variable and are transitional into one another, may be grouped as follows :—

A. Lutescens, ♀ f. n.

The white median band of F. and H.W.s of the *theobene* ♀ is more or less invaded by orange, which also often appears around the blackish spots of the irregularly curved row distal to the band and around the spots of the submarginal lunulate line. The black-brown basal area of both wings also acquires a yellowish tinge, and, in the darker examples, the sharpness of its distal edge is obscured. The orange may perhaps be explained by transference from the male, but it is commonly accompanied by dark pigment, the two together producing an appearance altogether different from the *theobene* ♀. The *lutescens* form is transitional on one side into *theobene* and on the other, by increase in the dark pigment, into the following :—

B. Nigro-lutescens, ♀ f. n.

In this form the dark pigment tends completely to overspread the white area of *theobene*, in both wings. Combined with it the orange, becoming very faint in the darkest examples, occupies the positions described above. In spite of this increasing faintness accompanying increasing darkness, the *nigrescens* forms, without the orange, are less dark than the majority of *nigro-lutescens.* The most extreme example of the latter (No. 8, p. 471) appears as an almost uniformly blackish butterfly with a faint yellow tinge in the region of the median band and one still fainter, indeed evanescent, in the more distal areas.*

C. Nigrescens, ♀ f. n.

In this form the dark pigment invades the white median band to a variable extent, in pronounced examples nearly obliterating it, in others replacing it by grey. In many specimens this invasion is strong in F.W., slight in H.W. As already stated, the pigment is less dark in this form than in *nigro-lutescens*, and the distal edge of the basal area and the spots of the curved and lunulate lines are more distinct than in any other form except *theobene* and the palest *lutescens.*

The under surface of the three forms usually differs but little from that of *theobene.* There is commonly an emphasis of the dark pigment, pronounced in the extreme forms, especially along the shadow-like outer border of the midrib-like stripe.

Lamborn's captured specimens, together with Farquharson's two bred varieties (p. 403), are arranged below, each set of forms in the order of increasing darkness.

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* It is interesting to note that parallel female forms are found in the allied S. African *C. alcimeda* Godt., as recognised by Trimen in "South African Butterflies," 1887, i, p. 314. In a series of 4 ♂, 9 ♀ captured by the Rev. K. St. A. Rogers at Eland's Kop (about 5000 ft.), about 30 miles S.W. of Pieter Maritzburg, March 12–21, 1919, 6 ♀ have the median band of the creamy colour described by Trimen on p. 313 (where the sign ♀ is accidentally replaced by ♂). The tint is deeper in F.W., and in one example may be described as pale yellow—as also in a ♀ from Llabisa, E. Centr. Zululand. In the remaining three Eland's Kop ♀ the yellow tint is greatly deepened in both wings, being pale ochreous in one, deep ochreous in the second, and nearly obliterated by fuscous in the third. There is a less strong fuscous invasion of the band in the two former, and all three may be considered forms of *nigro-fulvescens*, the third being very near *nigrescens.* The Eland's Kop examples are small, the females varying from 52 to 56 mm. in expanse, the males from 46 to 52.—E. B. P.

1. *Lutescens* ♀ f.: Oni. May 25, 1910. Orange tinge faint.
2. ,, ,, ,, Oct. 11, 1910. (Type.) Capt. *in cop.*
3. ,, ,, ,, May 27, 1910.
4. ,, ,, ,, July 18, 1912.
5. *Nigro-lutescens* ♀ f. Bred by Farquharson (p. 403) at Moor Plantation, Aug. 21, 1915. (Type.)
6. ,, ,, Oni. Aug. 7, 1910.
7. ,, ,, Oni. Dec. 1, 1908–Dec. 3, 1909.
8. ,, ,, Bred by Farquharson (p. 403) at Moor Plantation, Aug. 4, 1915. By far the darkest form with much the strongest "shadow" to midrib stripe on underside.

Then follow the *nigrescens* ♀ forms in the order of increasing darkness, but it must be remembered, much less dark than the majority of *nigro-lutescens*.

9. *Nigrescens* ♀ f.: Oni. Emerged Mar. 24, 1911, from pupa found Mar. 23. (Type.) Median band grey in F.W. nearly white in H.W.
10. ,, ,, ,, April 25, 1910. On black sticky exudation fallen from tree. Median band grey in both F. and H.W. Strong "shadow" to midrib stripe on underside.

All three forms fly with *theobene*, and there is no evidence of any local or seasonal difference between them. Thus half the individuals of the above list were taken in the forest up to a mile to the E. of Oni in 1910, while 7 examples of the *theobene* ♀ were captured in the same area between April 16 and June 5 of the same year. On May 25 and again on May 27 a *lutescens* (Nos. 1 and 3 respectively) was taken with a *theobene*. The wet season in 1910 had well set in by about April 25.

The table on p. 472 shows clearly the results obtained by Lamborn in his three breeding experiments; and here too in Fams. B and C, as well as in Farquharson's (p. 403), the *theobene* ♀ appears with one or more of the new forms.

Mendelian heredity is suggested by Fam. A, where all the female offspring are of the same form and all different from the female parent. It is to be hoped that breeding experiments may be repeated and carried far enough to test this suggestion. Considering the rarity of these new forms in collections it is remarkable that so many should have appeared in the four families recorded here and on p. 403.

Oni, 70 m. E. of Lagos: 1912.	Date of pupation.	Date of emergence.	Males	Females. *Theobene.*	Females. *Lutescens.*	Females. *Nigro-lutescens.*	Females. *Nigrescens.*	Remarks.
Family A, from ♀ parent (No. 767), *a worn lutescens f. like* (1) *but orange stronger in H.W. median band;* capt. in forest, 1 m. E. of Oni, Apr. 11; ova laid Apr. 13–17; died Apr. 19.	Apr. 27	May 4	1					
	,, 27	,, 5	2					
	,, 28	,, 5	3				3	♀♀ similar to type.
	,, 29	,, 6	2				2	,, ,, ,, ,,
	,, 30	,, 7					3	2 ♀♀ ,, ,, 1 w. darker H.W., like (10).
	Totals . .		8				8	
Family B, from ♀ parent (No. 768), *a typical theobene form;* capt. in forest 1½ m. E. of Oni, Apr. 13; ova laid Apr. 13–15; died Apr. 18.	Apr. 27	May 5	1					
	,, 28	,, 5	5			1		♀ slightly darker than type.
	,, 29	,, 6	3	1				
	,, 29	,, 7		1			1	♀ *nigrescens*, a dark var.
	,, 30	,, 7	1					
	Totals . .		10	2		1	1	
Family C, from ♀ parent (No. 771), *injured before capt., but probably a pale nigrescens f.;** capt. in forest 1½ m. E. of Oni, Apr. 13; ova laid Apr. 13–14; died Apr. 15.	Apr. 28	May 6	1					
	,, 29	,, 6	3	1				♀ trans. towards *lutescens*.
	,, 30	,, 7	1					
	May 1	,, 8	2					
	,, 2	,, 9				1		♀ similar to type but brighter orange.
	No record.	,, 9		1			1	♀ *nigrescens*, a dark var.
	Totals . .		7	2		1	1	

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* Very worn and the H.W.s nearly gone. Apparently a *nigrescens* f., very pale in the F.W.s, darker in the H.

VIII. *On the Larvae and Pupae of Lepidoptera, chiefly Lycaenidae, collected by C. O. Farquharson, W. A. Lamborn, and the Rev. Canon K. St. A. Rogers.*

By HARRY ELTRINGHAM, M.A., D.Sc.

PLATES XII, XIII. TEXT FIGURES 4, 5.

THE accompanying figures of larvae and pupae have been drawn from examples in the Hope Department at Oxford. The acquisition of Farquharson's specimens provided an opportunity of reviewing the whole of the material at our disposal, including the valuable contributions received from Mr. Lamborn and the Rev. Canon K. St. A. Rogers. It must be understood that as regards the pupae, in nearly every case the cuticle only has been available, the imago having emerged. The drawings are thus in the nature of restorations, and slight errors of shape may have occurred in those which were in a less perfect condition. The original colours have not been preserved and it is only possible to refer to the markings as light or dark, except in a few cases where they are described in the collector's letters.

a. LIPTENINAE.

Aslauga lamborni Bethune-Baker. Plate XII, figs. 4, 5.

Pupa. (Fig. 5.) A small much-contracted pupa attached by posterior extremity to a leaf, with the ventral surface in contact with the support. Chiefly remarkable for the presence on the pupa of chitinous growths of very remarkable formation. Such growths in one form or another are found on many Lycaenid larvae and pupae. They are of the same nature as the interlocking plates forming the armour of the larva of *Euliphyra mirifica* described by me, Trans. Ent. Soc. 1913, p. 509. As they are so marked a feature in Lycaenidae, and their structure is in many cases so elaborate, I propose the name *chitinanth*, a word kindly given me by Prof. Gilbert Murray to whom Prof. Poulton referred the matter. The meaning is of course "chitin flower" and is singularly appropriate. In the present species comparatively few remain on the pupa, but from an examination of the larval skin, it would appear that the larva itself is entirely covered with them.

One of the structures highly magnified is shown at Fig. 4. Length of pupa 8 mm. Lamborn, Oni. A ♀ emerged 3.2.12.

Euliphyra mirifica Holl. Plate XIII, fig. 3.

In an appendix to Mr. Lamborn's paper in our Transactions of 1913, I described (p. 509) the larva of this species, and the material then at my disposal suggested that the pupa was always partly enclosed in the old larval skin. (That of the Australian *Liphyra brassolis* Westw. is completely so enclosed, the larval skin forming a kind of puparium.) Further material shows that in this case the larval skin is not always, perhaps not generally, retained, since several examples are entirely without it. The pupa is attached by a sucker-like expansion of the terminal segments, and a depression of the abdominal segments forms a deep dorsal furrow. Its support is a leaf. On the thoracic region is a central ridge from which smaller ridges extend at right angles. The cuticle, especially of the abdominal region, is much folded and shrivelled. Length 19 mm. Lamborn, Oni. June–July 1912.

Epitola hewitsoni Mab. Plate XII, fig. 1.

Pupa. This remarkable pupa is attached by the terminal segments to its support and stands nearly at right angles thereto. Round the point of attachment are found remains of the larval skin, which was evidently clothed with long spines. The wing-cases have a beautifully marbled pattern, whilst the remainder of the cuticle bears dark irregular markings. The head has a blunt horn-like projection, the thorax has two prominent dorsal ridges, and there are large prominences on some of the abdominal segments. Scattered over the head and thoracic region and on various points of the abdomen are rounded tubercles from which arise thick curved spines. In nature the pupa is evidently extremely cryptic, its grotesque form doubtless serving to hide its outline more or less completely. Length 20 mm. Lamborn, Oni. 19.4.1910.

Epitola ceraunia Hew. Plate XII, fig. 3.

Pupa. A very pale pupa with a few black markings, notably on the wing-cases and the dorsal and lateral regions. The smooth prominent tubercles, which in the dry specimens are orange brown, form the most characteristic feature. From each of these projects a blunt spine. The greater part of the dorsal thoracic and abdominal areas sparsely set with very minute spines or setae. Pupa attached posteriorly to a leaf. The larval hairs combined with those of the posterior pupal segments are attached to the leaf in radiate formation. Length 15 mm. Lamborn, Oni. Emerged 22.2.12.

Epitola miranda Staud.

Pupa. I have not figured this pupa since it so closely resembles that of *E. ceraunia* that a separate illustration seems unnecessary. It is attached by the terminal segments, which are themselves clothed with long white hairs, resting on a cushion formed from the old larval skin. The long axis of the pupa is at right angles to the plane of its support. The dark markings are less irregular than in *ceraunia*. The 2nd abdominal segment bears a black, bracket-shaped transverse streak. On lateral prominences of the abdominal segments are a few very small chitinanths, and from these prominences on the 2nd, 3rd and 4th segments, there arise long fine bristles, which instead of projecting, are curved round the wing-cases. This feature is not shared by the pupa of *ceraunia*. Length 15 mm. Lamborn, Moor Plantation. Emerged 6.11.13.

Epitola concepcion Suff. Plate XII, fig. 13.

Pupa. Very pale with a few dark markings as shown in the figure. Small lateral clusters of delicate hairs, and on head, thorax, and abdomen, tufts of long chitinous processes having flattened dentate extremities. A few short setae scattered sparsely over the cuticle, and much longer ones projecting from the terminal segments. Length 12 mm. The example figured produced a male which emerged 2.11.13. Lamborn, Moor Plantation.

Epitola honorius Fab. Plate XII, figs. 16, 17.

Larva. (Fig. 17.) Medium dark ground-colour with still darker markings forming a rather complicated pattern. (Farquharson describes the general colour as brown.) Each segment with four tubercles from which arise tufts of fine sharp spines, and also longer delicate branched hairs. The whole cuticle is sparsely covered with fine short hairs. Length 16 mm. Farquharson, Shagamu. 8.9.15.

Pupa. (Fig. 16.) Of the shape and appearance shown in the figure. A prominent and characteristic dark marking on the thorax. Dorsal and lateral tubercles from which arise irregularly curved spines. Abdominal segments bear groups of chitinanths, each being surrounded by a dark ring on the cuticle. Dense hairs on the terminal segments combine with those of the larval skin to form a cushion round the point of attachment, the pupa lying nearly parallel to its support. Length 15 mm. Farquharson, Shagamu. Emerged 19.9.15.

Epitola ? sp. Plate XII, fig. 12.

Pupa. A small pupa the imago from which has not yet been identified. Dorsally the head bears two rather deep depressions, and the thoracic region is rounded and resembles a breastplate. Ground-colour very pale. A few slender black markings as figured. Numerous lateral tufts of chitinous projections gradually thickened towards their outer extremities, and having a dentate surface. Thoracic and abdominal surfaces sparsely clothed with very minute setae. A few longer setae projecting from the terminal segments. Length 12 mm. Lamborn, Moor Plantation. 6.11.13.

Epitola carcina Hew. Plate XII, fig. 18.

Pupa. Characteristically marked on thorax as shown in figure. The general surface sparsely clothed with fine setae. On thorax and abdomen tufts of short sharp spines, and on head, thorax, and abdomen lateral and dorsal groups of delicate chitinous projections which are white with black tips. Attached to leaf by terminal segments and lying nearly parallel to its support. Length 10 mm. The example figured produced a male, which emerged 8.2.12. Pupa, Lamborn, Oni. 7.2.12.

Teratoneura isabellae Dudgeon. Plate XII, figs. 7–9, 14, 15.

The general appearance of a dorsal view of the larva is shown at fig. 8. On each segment there are lateral and dorsal rows of tubercles from each of which arises a tuft of long fine hairs having the structure shown at fig. 15. The head and terminal segments are black, the former with a central pale streak flanked by two large pale spots. On segments 5 to 8 inclusive are dorso-laterally placed dark patches which consist of masses of urticating spicules. These are of the form shown at fig. 7. They are all slightly curved, but whether this is natural or due to the immersion in the preservative fluid cannot at present be decided. The whole larva has a very "Lymantrid" appearance, and the presence of urticating spicules on a Rhopalocerous larva is a very remarkable feature. Farquharson describes the larva as brightly pigmented with red, green, and yellow, and perhaps other colours, such as one associates with Lymantrid caterpillars. Length of larva 18 mm. Farquharson, Moor Plantation.

Pupa. The extraordinary pupa, shown at fig. 9, is attached by the terminal segments to its support, and the remains of the larval skin form a cushion of radiating hairs. On the 5th and 6th abdominal segments there is a conspicuous dorsal patch of yellowish brown, and a similar one just behind the head. The whole thoracic and dorsal surfaces are densely covered with elaborate chitinanths, which in many places are white. The effect of this is very peculiar. It gives the pupa the appearance of being mouldy, a fact to which I called attention before I knew that Farquharson had observed the same appearance in nature (p. 340.) Until I examined the pupa microscopically I quite thought it was mould, and that the specimens would have to be cleaned. In addition to the general covering by these structures, there arise from various points long branched filamentous chitinanths as shown in the figure. These add to the mouldy appearance. Length 15 mm. ♂ emerged 9.12.17, at Agege, larva from Moor Plantation, Ibadan. C. O. Farquharson.

Iridopsis incredibilis Staud. Plate XII, figs. 6, 10.

Pupa. As will be seen from fig. 10, the shape of this pupa is quite unusual, its form gradually widening from the posterior to the anterior end. The cuticle is covered with chitinanths both stellate and annular, and also with long delicate filaments bearing plume-like expansions at their extremities. A small portion of the cuticle is shown at fig. 6 highly magnified. From the terminal extremities project tufts of long hairs which blend with those of the larval skin, forming a dense cushion at the point of attachment. The pupa lies flat with the ventral surface in contact with the bark. The larva was evidently clothed with silky hairs. There is a considerable quantity of silk on the bark, round the pupa, forming a kind of elementary cocoon. Length 12 mm. The example figured produced a male which emerged 30.9.15. Farquharson, Moor Plantation.

Citrinophila tenera Kirby. Plate XII, fig. 11.

Pupa. This little pupa was attached to bark of the Pará Rubber tree on which it lay with the ventral surface in contact. The thoracic region, which is dark in colour, bears a prominent dorsal ridge, and along the whole length of the pupa are dorso-lateral prominences from which arise long branched hairs. The still longer hairs of the larval skin radiate in masses from the point of attachment. The general appearance is extremely cryptic. Length 7 mm. Farquharson, Agege. 18.10.17.

Hewitsonia similis Auriv. Plate XII, fig. 2.

Pupa. Ground-colour very pale with some very small black markings on wing-cases and black-and-white dots on the remainder of the cuticle. A darker " arrow head " pattern on the dorsal thoracic region. The black-and-white dots are really chitinanths of simple structure, flat and of reniform outline. From various points of the cuticle arise long needle-like spines, some of which are black and some white. The lateral portions of the abdominal segments are flattened and expanded, and the last four segments are separated from the rest by a constriction. The general appearance reminds one of some large species of Coccid. It is attached terminally to a piece of bark and lies flat upon it. Remains of the larval skin show it to have been clothed with long fine branched hairs. Length 17 mm. Lamborn, Moor Plantation. Emerged 28.11.13.

b. LYCAENINAE.

Tanuetheira timon F. Plate XIII, figs. 5, 7, 11.

Larva. The drawing reproduced in fig. 7 must be regarded as to some extent diagrammatic, since from Farquharson's notes it seems doubtful whether the head and legs are in life so prominently displayed as in the sketch. The colour is described as " dull green," like the larva of *A. paneperata*. The larva may be described as onisciform, the dorsal portion forming a ridge segmentally divided into stiff plates, the upper edges of which are projected backwards so as slightly to overlap. Anteriorly these plates form projections round a deep cavity the general arrangement of which can best be understood from the figure. The head in the preserved example is pointed vertically downwards, though this is probably not a natural position. The lateral parts of the segments form a kind of mantle which, when in close contact with the support, completely covers and protects the head, legs, and ventral surface. The last segment is prolonged into a bifid process. The larval cuticle is of comparatively enormous thickness and consists of a dense fibrous tissue carrying dorsally a number of small hooked spines. The surface of the cuticle, fig. 11, shows, under a medium magnification, a delicate tracery having a squamoid pattern, and fairly evenly distributed upon it are great numbers of chitinanths, resembling in shape single roses, in many cases bearing a partially or completely expanded chitinous tuft. As the tufts are easily broken it seems probable that normally they are always formed, and that where only the rose formation remains they have become detached. Length 16 mm. Farquharson, Moor Plantation. Dec. 1917–Feb. 1918.

Pupa. The pupa is shown, not quite complete at fig. 5. It is difficult in a mere black-and-white sketch to suggest its extraordinary resemblance to a bud. The terminal segments are progressively tapered towards the point of attachment, and the long axis of the pupa forms a sinuous curve giving it a most characteristic shape. Judging from the appearance of the dry skin, the original colour is green, somewhat darker towards the point of attachment. The central portion of the dorsal surface is also darker, as are the wing-cases, thus giving the lateral parts a close resemblance to the green part of the expanding bud. Length about 15 mm. Farquharson, Moor Plantation. Jan.–Feb. 1918.

Argiolaus paneperata H. H. Druce. Plate XIII, figs. 9, 18.

Larva. Fig. 9 shows the larva with head and feet retracted. It is really rather similar to that of the previous species, but differs in the much simpler structure of the anterior segments. Farquharson describes the colour as "a sort of mistletoe-leaf green," exactly resembling the immature flowers which are "dull green—a sort of bud-scale green shot with brownish hairs" (pp. 368, 372). The cuticle, a surface view of which is shown at fig. 18, has the same squamoid markings, but the chitinanths are of a different type, being merely tufts without the elaborations shown in *timon*.

Pupa. All the pupa skins are much shrivelled, but it is evident that the abdominal segments differ from those of *timon* in being less rounded, and so forming a marked dorsal angle. The whole effect is less bud-like, and the pupa seems generally to be attached to a leaf instead of to a stem. The cuticle is smooth. Length 15 mm. Farquharson, Moor Plantation. Jan.–Feb. 1918.

Argiolaus iulus Hew. Plate XIII, fig. 4.

Pupa. The general shape of this pupa recalls that of *T. timon*, being somewhat bud-like, though it would appear usually to be attached to a leaf. The terminal segments are very narrow suggesting a stalk, and the last, though but little expanded, has the sucker-like formation noted in several other species. The dorsal area is covered with punctulations, and a very conspicuous feature is the presence on the fourth and fifth abdominal segments of two large yellow patches outlined in black. The thoracic portion of the skin is in all the specimens too distorted for accurate representation. It is noticeable that the pupa of *iulus* bears a greater resemblance to that of *T. timon* than to those of other species of its own genus. The example shown produced a male which emerged 25.2.17. Length of pupa 15 mm. Farquharson, Moor Plantation.

Argiolaus alcibiades Kirby. Plate XIII, fig. 2.

Pupa. This pupa does not present any very marked features of interest. As the figure shows, the dorsal aspect is somewhat coffin-shaped and the cuticle is finely granulated. Attached to support by a sucker-like expansion of the terminal segment. It is described as "apple or Alga green—not shining but dull green like the surface of a tomentose leaf." Length 18 mm. The example shown produced a female which emerged 23.1.18. Farquharson, Moor Plantation.

Argiolaus ? sp. (nr. **silarus** H. H. Druce). Plate XIII, fig. 1.

The pupa figured is somewhat like that of *iulus*, but the dorsal markings are more extensive and elaborate. The surface is comparatively smooth and in the dried specimen the ground-colour is deep ochreous with the markings in brown. In life they are described by the Rev. Canon K. St. Aubyn Rogers as fairly bright green, the variable dark markings having paler centres. A single pupa was purplish brown. There are three examples, all attached to *Loranthus* leaves. Two were taken by Canon Rogers and bear the label "Kongwa, Tanganyika Territory, 1917," and one by Lamborn labelled "Tanga, 1917." Length 15 mm.

Argiolaus maesa Hew. Plate XIII, fig. 17.

This pupa bears a remarkable resemblance to a gall, and is attached to a leaf by a sucker-like expansion of the terminal segment. The remaining abdominal segments are rounded and swollen and bear two very conspicuous black depressions in the dorsal line, suggesting the openings from which the gall insects have emerged. Judging from the faded colour of the pupa case the posterior part is green, matching the support. The cuticle is devoid of hairs, but is finely punctulated and bears a few slight projections. The gall-like appearance in life must be extraordinarily close, for Lamborn described in a letter from Moor Plantation, September 30, 1913, how he had shown, first a Liptenine pupa and then one of *A. measa* on its leaf, to Farquharson, who made out the first but examined the second "in a casual way, remarking, 'A beautiful gall! Something has evidently come out of it.'" The two dorsal marks had also previously suggested to Lamborn that some insect had emerged. The pupa of *maesa* was then taken to another scientific friend who said, "'A gall, isn't it?' his manner suggesting that he rather wondered at being shown such an ordinary thing." Length 13 mm. From the example figured an ichneumon emerged 26.12.13. Lamborn, Moor Plantation.

Epamera laon Hew. Plate XIII, fig. 15.

Pupa. The abdominal segments are much rounded, resembling the previous species. The thoracic portion is ridged and angulated and the whole cuticle is punctulated and bears numerous ridges and prominences. It is especially to be noted that the pupa in its natural position is placed with its long axis nearly at right angles to the stem to which it is attached, as in the case of *Epamera farquharsoni*. Farquharson describes the larva of this species as dark mole-colour with one or two tiny white and brown spots posteriorly. It is very cryptic and, except in colour, resembles that of *Epamera farquharsoni.* The example figured produced a male which emerged 2.3.12. Length 11 mm. Lamborn, Oni.

Epamera farquharsoni Beth.-Bak. Plate XIII, figs. 6, 10, 12.

Larva (fig. 6). This larva is described as "wonderfully cryptic" and is of a green colour with tiny points of brown or red. I have drawn it from the dorsal aspect, as that point of view seems best to illustrate the very remarkable "mantle edge" or fringe of processes, which evidently enable the insect to blend so perfectly with the surface on which it is resting as to make it practically indistinguishable. These processes are extensions of the thick fibrous cuticle and their irregular outline adds greatly to their efficacy. The dorsal part of the larva is not ridged, but rounded, its regularity broken by small raised processes as shown in the figure. Farquharson records how, having found one of these larvae, he immediately afterwards cut another in two before realising its presence (p. 368). The cuticle (fig. 12) differs considerably from that of *timon* and *paneperata.* It does not show the squamoid surface, and the chitinanths, though somewhat resembling those of *paneperata,* are nevertheless quite distinct. Length of larva 18 mm. Farquharson. Moor Plantation, Jan. 1918.

Pupa. Fig. 10 shows one of the pupa-cases in its natural position just above a flower cushion of the *Loranthus.* It is placed with its long axis at right angles to that of the stem, and in nature is probably far less conspicuous than it appears in the drawing. The pupa is very short, the abdominal segments well rounded, and projecting high above those of the thorax. The whole surface is rough and irregular with occasional smoothly rounded tubercles. On the 1st abdominal segment is a slight concavity very darkly coloured and having the appearance of a hole. The mark is nearly round, but appears slightly elongated in the drawing owing to the foreshortening. There is a smaller more rudimentary mark on the next segment. These marks produce an effect which is much more highly elaborated in the "gall" pupa already described. Length 12 mm. Farquharson, Moor Plantation. Jan. 1918.

Hypokopelates nigra Beth.-Bak. Plate XIII, fig. 19.

Pupa. The pupa is attached along its ventral surface to the underside of a leaf and resembles somewhat that of *Pilodeudorix diyllus* (fig. 8), and is darkly marbled on a slightly paler ground-colour. The cuticle is smooth, but bears numerous very minute hairs. A portion of the larval skin remains attached to the leaf, and from this I have made a preparation which shows the larval cuticle to be covered with chitinanths of the forms shown at fig. 19. Length of pupa 10 mm. From the example figured the male type emerged 16.5.12. Lamborn, Oni.

Lachnocnema bibulus F. Plate XIII, fig. 21.

Pupa. The cuticle of the abdominal segments is thrown into a multiplicity of folds, giving it a very rough appearance, and the peculiar structure of the terminal segments is shown in the figure. At the head are two processes, and the thoracic portion is wavy and irregular. The example shown produced a male, which emerged 1.12.13. Length of pupa 10 mm. Lamborn, Moor Plantation.

Lycaenesthes liodes Hew. Plate XIII, fig. 20.

This small pupa calls for little remark. Its general appearance is shown by the figure, and the cuticle is smooth and bears a sparse but regular covering of very minute hairs. The example shown produced a male which emerged 10.12.13. Length 10 mm. Lamborn, Moor Plantation.

Zeltus sp. ? **lebona** Hew. Plate XIII, fig. 16.

A small perfectly smooth pupa, pale in colour with slightly darker markings. Length 6 mm. Emerged 27.1.12. Lamborn, Oni.

Megalopalpus zymna Hew. Plate XIII, fig. 13.

This curious pupa is remarkable for its elongated form and absence of irregular projections. It is ornamented all over with dark markings which give it a delicately marbled appearance, and on the abdominal segments are smooth rounded processes. It is attached by the terminal segment, its long axis making a slight angle with that of the twig. Length 7·5 mm. Emerged 25.2.12. Lamborn, Oni.

Pilodeudorix diyllus Hew. Plate XIII, figs. 8, 14.

Larva (fig. 14). The colour of the preserved example is fairly uniform and rather dark. The 1st segment is rounded and covers the head, the remainder, to the 9th, present lateral blunt processes and a double row of dorsal projections. The last three segments are of somewhat peculiar shape, as shown in the drawing. The whole surface is covered with fine short spines. Length 14 mm.

Pupa (fig. 8). Attached so that the ventral surface is in contact with the support. The cuticle is smooth and, except for the wing-cases, has a sparse coating of very minute hairs. The dried example is dark brown marbled all over with black. The general shape is shown by the figure. Length 11 mm. The example figured produced a male 13.3.17. Farquharson, Moor Plantation.

c. NOTE ON THE PRESENCE OF GUENÉE'S GLAND.

With regard to the presence or absence of a honey-gland in the larvae of this series which I have examined, there is in that of *Argiolaus paneperata* a slightly paler mark on the 7th abdominal segment, and the distinct appearance of a slit. Lamborn (Trans. Ent. Soc. 1913, p. 475) records the presence of a dorsal gland in the larva of *Argiolaus iulus.* I have not found a similar structure in the larva of *Tanuetheira timon* or in that of *Epamera farquharsoni*, though it might well be hidden by the chitinanths which abound on the cuticle of these species. In the case of *Teratoneura isabellae* and *Epitola honorius* there are so many lines and markings on the cuticle that the presence of the slit would probably be effectively disguised. It would seem very probable that the long and numerous hairs on these larvae are hardly consistent with the presence of active honey-glands. In *Pilodeudorix diyllus* I have not found any outward sign of the presence of the gland. (See, however, pp. 382–83, almost certainly referring to these, by far the commonest *Pterocarpus* Lycaenid larvae).

d. ON THE "ELECTRIC" SENSATION CAUSED BY LYCAENID LARVAE.

One of the most interesting of the late Mr. Farquharson's observations is the suggestion that some of his "Loranthus" larvae, and especially that of *Tanuetheira timon,* are capable of giving a mild electric discharge (see p. 376). It is most unfortunate that further and more precise experiments were not made with these larvae, such as contact with an electroscope or voltmeter. A shock such as could be felt by the human hand would necessarily be of considerable electrical pressure, and for so great a discharge from creatures so small as the larvae in question, some elaborate development of electroplaxes would be expected. I have made numerous sections of the larvae, and at first, not being familiar with the immensely thick fibrous cuticle possessed by them, I was inclined to suppose that, in spite of its lack of resemblance to known forms of electric tissue, this unusual structure might be the source of the phenomenon. Comparison with some of our native species showed, however, that this special cuticle was not peculiar to the supposed electric larva. Our own Lycaenid larvae such as *betulae* and *quercus* are similarly endowed, though they do not appear to afford any electric manifestations. The cuticle of the larva of *timon* is extremely rough and would therefore cause considerable friction between itself and the human skin. In view of this it appeared to me that if the larva were capable of producing, when handled, extremely rapid muscular contractions or vibrations, an effect such as that described might well be produced on the delicate tactile nerve-endings of the human skin. After theorising in this way, I had the opportunity last spring of examining some larvae of *T. pruni*, which in general appearance are not unlike those of *timon*. I was examining one of them under the stereoscopic microscope when I was interested to note that it did in fact "shiver" at short intervals. The movement was not sufficiently rapid to produce an electrical sensation, but it at least demonstrated that such muscular vibrations are possible. I do not wish to convey the impression that the electrical theory is necessarily erroneous, but in the absence of tissue having any resemblance to known forms of electroplax, other possibilities should have due consideration. The yellowish points which Farquharson regarded as the centres of the discharge are almost certainly the chitinanths already described.

e. ON THE PROLEGS OF LYCAENIDAE.

On the figure of the larva of *Tanuetheira timon*, Pl. XIII, fig. 7, small processes may be observed on the prolegs.

Similar structures are found* on the prolegs of *Teratoneura isabellae,* and one of these is illustrated on a larger scale on Pl. XII, fig. 14. They consist of small diverticula of the cuticle, extensible by internal fluid pressure. We have discussed these structures with Dr. T. A. Chapman, F.R.S., who has given us much valuable information on the subject. In most Microlepidoptera there is on the prolegs a complete circle of hooks, whilst in most Macrolepidoptera half the circle has become atrophied. Dr. Chapman states that he formerly expressed the opinion that it was the outer half of the circle which had been preserved and the inner half lost. He now considers that the reverse is the case and that in those species in which but half the circle of hooks remains, it is the inner half which persists. Now within this circle of hooks there is a kind of pad which can be protruded or withdrawn. This action gives to the hooks a rocking motion by which they engage and disengage with the surface on which the larva is progressing. There can be but little doubt that the papillae observed in many Lycaenid larvae are really developments of the centre of the extensible pad, and that they assist the larva by adhesive or tactile functions, or perhaps both. On this point see Farquharson's account on pp. 352, etc. That this is almost certainly the correct interpretation of the development of the papilla is shown by text fig. 4, which is a section

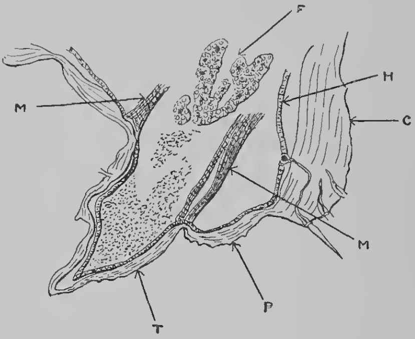

Fig. 4.

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* Some of the detail of the original drawings has been lost in reproduction. Most of the figures will, however, bear examination with a low-power hand lens.

of the structure as found in *Callophrys rubi*. T is the papilla, P the position of the surviving hooks of the proleg, M is the muscular tissue, F the fat body, H the hypoderm, and C the cuticle. It will be seen that the papilla is not a separate organ, but is, as already indicated, a diverticulum of the cuticle. Incidentally the section supports the view that it is the inner half of the hooks which persists.

f. NOTE ON A REMARKABLE GEOMETRID LARVA.

Amongst the specimens sent home by Mr. Farquharson is a Geometrid larva which he describes as having the appearance of a small centipede. Unfortunately it was not on its food-plant and was the only example found by him, so that there is no means of identifying the species. The example I have figured is about 15 mm. in length. It was evidently undergoing a moult as parts of the old cuticle became detached on touching it. Text fig. 5, A shows a dorsal view. The first two segments are expanded and flattened, fused together, and dorsally slightly concave. They completely hide the head, at the same time forming a false head, the effect being much enhanced by the first pair of spiracles, which are black and so placed as to resemble eyes. The 3rd segment is more or less normal, but the 4th to 8th inclusive have large lateral expansions. The

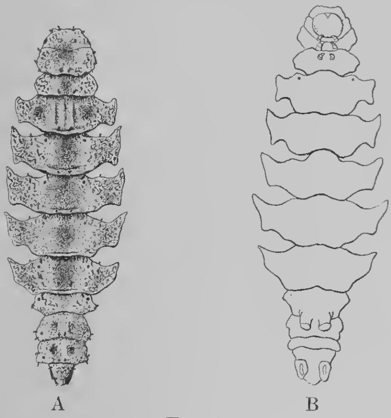


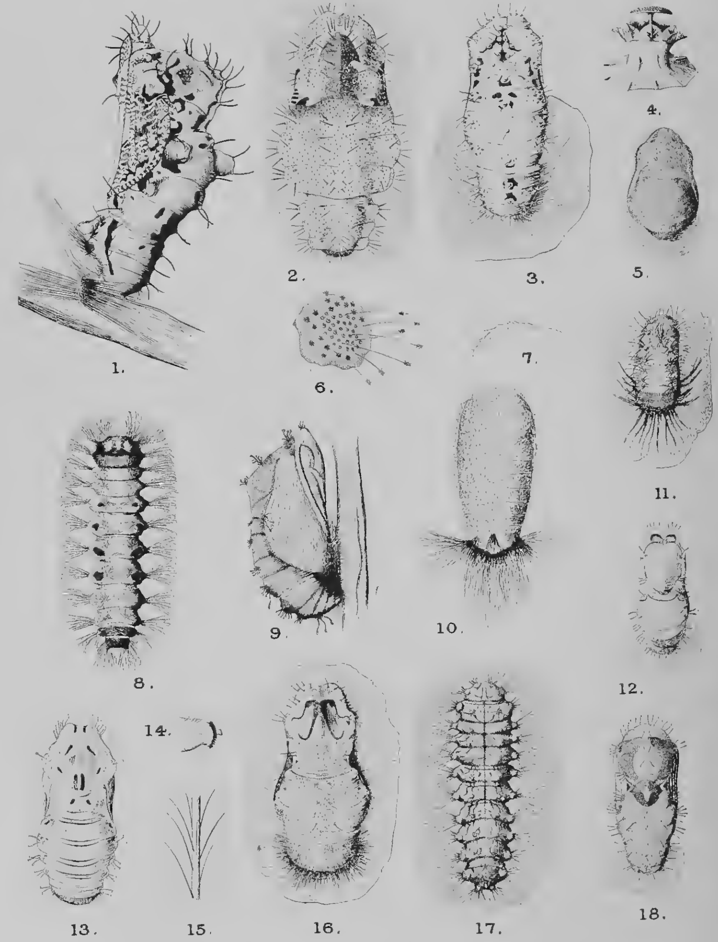
FIG. 5.

spiracles of the 1st abdominal segment are completely displaced and appear on the underside. The 6th, 7th, and 8th abdominal segments are reduced in width, and the 9th and 10th more or less fused together. The whole cuticle is very rough and covered with minute wart-like protuberances in masses of ochreous and dark brown which produce a marbled effect. One of the many surprising features of the larva is the presence at many points of chitinanths, resembling those hitherto only found in Lycaenid larvae. At text fig. 5, B is a diagrammatic drawing of the underside to show the position of the true head, the first pair of spiracles, and the usual Geometrid prolegs. Farquharson refers to the larva as a "looper," so that we may assume that when alive it adopted that familiar method of progression. Mr. Prout has kindly examined the drawings of the larva and thinks it is certainly a Geometrid "perhaps an Emerald." I am indebted to Sir Geo. Hampson for reference to another Geometrid larva with which it may be compared. It is that of *Uliocnemis cassidara* Guén. (= *Comiboena biplagiata*) and is illustrated in Hampson, Ill. Het. IX (p. 145), Pl. 176, fig. 18, from a drawing by Mr. E. E. Green. It is described as yellowish drab, sides of the somites produced into fleshy processes on which the larva fastens small pieces of withered leaves and stick, as a disguise. It rests with the thoracic somites doubled under the body. Ceylon.

In this case the processes are not flattened but are in the form of tubercles. The appearance of the resting larva in its curious attitude and with its decoration of particles of dead leaf is very peculiar and evidently highly protective. Farquharson's larva was found at Agege, Oct. 18th, 1917.

g. ON THE COCOON OF CHIONEMA FARQUHARSONI B.-B.

The single example of this new species of Lithosid moth emerged from a pupa enclosed in a remarkable cocoon. The latter consists of an extremely thin silken bag covered all over with what are evidently the larval hairs. Each of these consists of a central stalk covered with innumerable fine branches, and each hair is attached to the cocoon by one end, so that all radiate from the centre, the result being a regularly constructed ball of mouse-coloured down. (See also p. 464.) Farquharson, Moor Plantation. 1916–1917.



H. Eltringham del.

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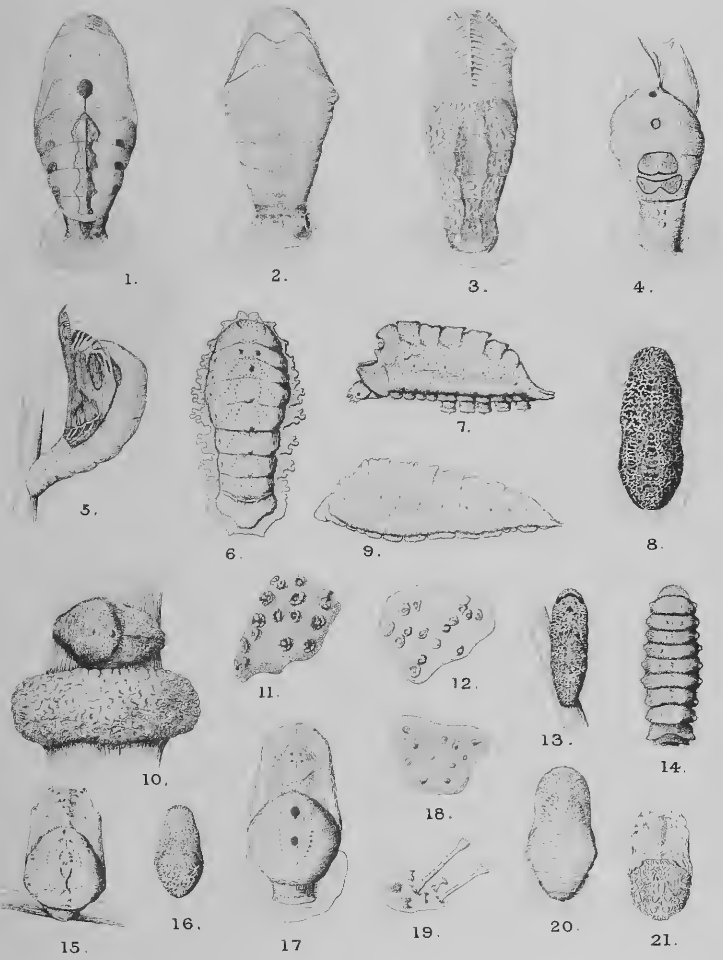
LYCAENID LARVAE AND PUPAE.

Trans. Ent. Soc. Lond., 1921, Pl. XIII.



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LYCAENID LARVAE AND PUPAE.

EXPLANATION OF PLATE XII.

LIPTENINAE.

FIG. 1. *Epitola hewitsoni*, pupa.
2. *Hewitsonia similis*, pupa.
3. *Epitola ceraunia*, pupa.
4. *Aslauga lamborni*, a chitinanth.
5. ,, ,, pupa.
6. *Iridopsis incredibilis*, part of pupal skin.
7. *Teratoneura isabellae*, one of the urticating spicules.
8. ,, ,, larva.
9. ,, ,, pupa.
10. *Iridopsis incredibilis*, pupa.
11. *Citrinophila tenera*, pupa.
12. *Epitola* sp., pupa.
13. ,, *concepcion*, pupa.
14. *Teratoneura isabellae*, proleg with papilla.
15. ,, ,, part of one of the long hairs of larva.
16. *Epitola honorius*, pupa.
17. ,, ,, larva.
18. ,, *carcina*, pupa.

EXPLANATION OF PLATE XIII.

LYCAENINAE (except Fig. 3).

FIG. 1. *Argiolaus* sp. near *silarus*, pupa.
2. ,, *alcibiades*, pupa.
3. *Euliphyra mirifica*, pupa.
4. *Argiolaus iulus*, pupa.
5. *Tanuetheira timon*, pupa.
6. *Epamera farquharsoni*, larva.
7. *Tanuetheira timon*, larva.
8. *Pilodeudorix diyllus*, pupa.
9. *Argiolaus paneperata*, larva.
10. *Epamera farquharsoni*, pupa.
11. *Tanuetheira timon*, part of larval skin with chitinanths.
12. *Epamera farquharsoni*, part of larval skin with chitinanths.
13. *Megalopalpus zymna*, pupa.
14. *Pilodeudorix diyllus*, larva.
15. *Epamera laon*, pupa.
16. *Zeltus? lebona*, pupa.
17. *Argiolaus maesa*, pupa.
18. ,, *paneperata*, part of larval skin with chitinanths.
19. *Hypokopelates nigra*, larval chitinanths.
20. *Lycaenesthes liodes*, pupa.
21. *Lachnocnema bibulus*, pupa.

IX. *The mature Larva and Pupa of Catochrysops phasma Butl.* (*Lycaeninae*). By Dr. T. A. Chapman, M.D., F.R.S.

The larva preserved in spirit of *C. phasma* has the colourless aspect of a hidden feeder (like *Lycaena arion* L., which is pale flesh-colour). Length—14 mm.; width mesothorax—4·5; 4th abdominal segment—5·0; 7th abdominal—4·5. Has the appearance of being distended, with segments approximately circular in transverse section. Ventral surface straight from 2nd thoracic to posterior end; prothorax a little projecting ventrally and head (on a neck) projecting ventrally 1·3 mm. Dorsum is curved, from front of prothorax, which is a little below the ventral line (of median segments), rising quickly over prothorax, then in a regular sweep, highest, of course, over 4th abdominal segment, with quite a hump over honey-gland and then sloping to end of 10th abdominal, which projects 0·6 mm. behind claspers which are placed nearly 1 mm. from the margin of segment towards the mid-ventral line.

The hinder portion of left side is darkened by some disease or *post mortem* change; the rest is of a very pale flesh tint, which may, of course, be lighter or darker than that during life. There are small brownish patches a little way above prolegs (not quite a third of the way to spiracles): these brownish areas are roundish and wrinkled, and a little depressed centrally and, though uncoloured, exist on segments forward to mesothorax.

The spiracles have a somewhat dorsal position and are brownish. There is a fringe of short hairs on anterior margin of prothorax and at cxtremity of last segment. The general surface looks glabrous, but there exist single hairs below the spiracles and possibly elsewhere (on primary tubercles?), and the general surface shows the skin-points as minute hairs. The prolegs have each two pads (almost united), carrying black crochets, 8 on the anterior and 7 on the posterior, in two rows, alternating but all of same size; there is also the usual separate central pad. The true legs are small (about 0·5 mm. long) and black, but brown when mounted and seen by transmitted light. They havc at their bases a few short hairs, and just above each is a patch of hairs of which two are about 0·6 mm. long, four or five shorter and a few others graduating down to the ordinary skin-point hairs.

The head is black, very small for a larva of this size—0·7 mm. wide. The antero-posterior head measurement is about 0·4 mm. and of the neck 0·8 mm. It may or may not be stretched to its full length, but looks as if it were. *Arion* has a still smaller head—0·6 mm. across, but that species has a very special history as to moults, etc.

The hairs on the front margin of the prothorax are numerous and a good many are as long as those above the legs, viz. 0·6 mm. The prothoracic plate is not defined or tinted in any way; two flights of lenticles, one to either side of the middle line, may indicate its lateral wings. A few hairs about 0·25 mm. long are at the end of last segment, and the bases of the prolegs have some hairs rather longer than the ordinary skin-point hairs. On each abdominal segment from 3rd to 6th there is a longish hair (about 0·3 mm.) at the middle of the segment, a third of the distance from the proleg to the spiracle. This has about it some hairs rather larger than the usual skin-points. Dorsally, in fact above the spiracles, there appear to be no hairs, except the fine skin-points. Each of what appear to be the usual skin-points carries a very fine hair, about 0·04 to 0·06 mm. long. Small lenticles are numerous. These are only about 0·03 mm. in diameter; some have the usual dotted closing membrane, others have a central portion in the membrane somewhat denser, as though it represented an abortive hair. Most of the lenticles look as if the sides were conical frustra, nearly half their width in height. Below the spiracles they are less numerous—about 6 on the forward segments, increasing to 12 or 16 on the posterior.

Above the spiracles, the segments are divided into an anterior and posterior subsegment by a narrow band defined by the skin-point hairs being wanting for some way above the spiracles, and, across the dorsum, by a want of lenticles. On the anterior subsegment are about 80 lenticles irregularly disposed but most numerous above the spiracles, sparse dorsally. The posterior subsegment is divided into an anterior portion carrying a band of lenticles and a posterior without them; these number about 120; they are least numerous near the spiracles, but abundant on each side of the dorsal line, along which, however, they are absent. The spiracles, 0·12 mm. across, are brown (in the preparation), and are raised, by their chitinous sides being conical, to a height nearly equal to their width.

The existence of a honey-gland is highly probable, since a local disease or injury that obscures the region and prevents a definite statement being made, is a frequent result of captivity in larvae whose honey-glands are deprived of the proper stimuli to exercising their normal activities. In this larva the gland seems to have been the centre of some disorder, causing the brown coloration of the larva, and, just outside it, is what looks like a premortem wound. The brown chitinous-looking wrinkles about it are probably merely pathological. Ordinary lenticles are not in excess about it, but there are close to it many very small, nearly colourless lenticles, about half the width of the others. There is no fan on 8th abdominal segment, but at its probable position is a chitinous arc, lost in the diseased condition on one side, but looking like a normal structure on the other.

The interior structures present various larval organs, especially tracheae and fat-masses, but no trace of anything that could be supposed to be a part of an ant larva or pupa. Indeed, the intestinal canal was barely recognisable and empty. The mandibles have eight teeth all sharp and pointed, and the middle ones rather long; they suggest, though not perhaps very decisively, a carnivorous employment. *Arion* has similar sharp teeth, but they are also found in purely vegetarian larvae, such as *icarus*. There were no traces of imaginal organs.

The pupa of *C. phasma* is of a nearly uniform dark terra cotta colour and of the usual Lycaenid form, 13·0 mm. long by 5 mm. broad. It is for the most part remarkably free from hairs and lenticles of any sort, but round each spiracle (abdominal) are a dozen or two minute hairs, colourless and glassy, about 0·06 to 0·08 mm. long; each has a solid shaft for about half its length, the remainder divided into several, usually a good many, radiating spicules sometimes arising together, sometimes a little spread over the end of the shafts; some smaller similar hairs are seen on the prothorax.

The 8th abdominal segment narrows ventrally almost to disappearance, the 9th gives a small triangular midventral projection, and the 10th a rather larger rounded projection, about 1·3 mm. across and 0·7 mm. long. Dorsally the 9th and 10th are not separately distinguishable;

the rather large piece overhangs the venter and its point is the most projecting portion of the ventral line; it is about 1·6 mm. long by 2·0 broad. It terminates in a low ridge and a few points darkly chitinised, almost black, with half a dozen anchor-ended cremastral hairs.

The appendages of the male butterfly did not suggest alliance with any groups I know, certainly not with *Lycaena* (*arion* L.), and almost equally not with *strabo* (type of *Catochrysops*). I am not familiar with the group to which it belongs, but various butterflies that have the same type of markings seem to have appendages very different from each other.

X. *Description of a new Genus and Species of Tineina (Lep.) from Southern Nigeria.* By J. HARTLEY DURRANT.

HYPONOMEUTIDAE.

MNEMOSES, gen. n. (Drnt.).

(μνῆμα = a memorial; σής = a moth).
Type : *Mnemoses farquharsoni* Drnt.

Antennae 2/3, uniserrate, the serrations ciliate; basal joint elongate, somewhat enlarged, with pecten of long hair-scales. *Labial Palpi* moderate, subascending, loosely scaled, terminal joint shorter than median. *Maxillary Palpi* short. *Haustellum* moderate, scaled. *Ocelli* obsolete. *Head* loosely hair-scaled. *Thorax* smooth. *Forewings* elongate-ovate; *neuration* 12 veins; 1 furcate at base; 3 from angle, 3–5 approximate, 4 slightly nearer to 3 than to 5; 7–8 closely approximate at base, 7 to below apex; 9–10 stalked; 11 from areole, at slightly beyond half its length; a subcostal stigma above 12. *Hindwings* almost 1, subovate, evenly rounded from apex; *neuration* 8 veins; 3–4 connate, or from short stem; 4–7 nearly parallel, 5 nearer to 6 than to 4; discoidal obliquely receding from 3 to 7; 12 not connected to radius; 1^{bc} furcate at base. *Abdomen* rather long, somewhat flattened. *Legs:* hind tibiae with long hair-scales.

Apparently most closely allied to *Eremothyris* Wlsm. and *Anticrates* Meyr., but differing from both in FW. 11 arising from the areole, and in the clothed hind tibiae.

Mnemoses farquharsoni, sp. n. (Drnt.).

Antennae yellowish, basal joint white. *Palpi, Head* and *Thorax* shining white. *Forewings* chalk-white, with pale leaden grey markings: a large cordate grey patch occupies the apical third and is connected narrowly along the termen to a tornal patch expanding above the dorsum to almost half its length; above this, narrowly separated from the apical patch, is an ovate patch of the same colour, and along the costa, above and towards the base is a grey irroration, below which, on the fold, in the basal third, is a subovate grey patch; cilia shining white; underside pale leaden grey, the margins and cilia white. *Exp. al.* ♂ 18–21 mm. ♀. *Hindwings* pale leaden grey; cilia shining white. *Abdomen* shining white. *Legs* shining whitish; hind tarsi leaden grey.

Type ♂ (350484); ♀ (350485); *slide* ♀ (350487) B.M. [*PTT*. 7772–3, 7775–9, 7781, 7783, 7785–7 (Drnt. Det. 1920). Hope Dept., Mus. Oxf.].

Hab. AFRICA, W.: LAGOS: Agege, ⊕ ivory whitish, head yellowish; under mantle of gnawed bark and frass on trunks of *Hevea brasiliensis* Müll. Arg., ex. 23. IX—11. X. 1917; Jan. 17, 1918. (*C. O. Farquharson*). Fifteen specimens.

By request of Prof. Poulton this species is named after the late Mr. C. O. Farquharson.

D. DIPTERA.

XI. *A Revision of the Genus Harpagomyia de Meij.* (*Diptera, Culicidae*). By F. W. Edwards.

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Plate XVI, figs. 5–12, facing p. 517. Text Figure 6.

The genus *Harpagomyia* was founded by de Meijere in 1909 for a Culicid fly found in Java by Jacobson, with very remarkable habits, and with a most pronounced adaptation of its mouth-parts, the mandibles and maxillae in both sexes being absent. In the previous year the same fly had been described by Leicester under the name *Malaya*, but this name has been considered by the present writer (1912) to be preoccupied by the Coleopterous genus *Malaia* Heller, and that being so, de Meijere's name can be used for the genus. This is fortunate, for de Meijere's work was much more detailed than Leicester's, the latter author merely describing the external characters of a single male specimen caught in a bungalow. Shortly after de Meijere's paper appeared, the genus was again described by Theobald (1909) under the name *Grahamia*, but this was corrected to *Harpagomyia* in the last volume of his monograph (1910).

The genus may be characterised as follows :—

Eyes contiguous or narrowly separated. Head clothed only with broad flat scales with rounded ends. A pair of strong vertical bristles present, separated by a wide space from the orbital bristles. Clypeus rather long and narrow, somewhat tapering. Palpi alike in the two sexes, scarcely longer than the clypeus and in close contact with the base of the proboscis; jointing indistinct. Antennae alike in the two sexes; flagellar joints all about equal in length and with moderately long basal hair-whorls. Proboscis rather short, hairy, directed backwards beneath the body when at rest; labella very large, thicker than the proboscis and nearly one-third as long, carrying two pairs of very long curled hairs. Mandibles and maxillae absent. Prothoracic lobes separated, completely clothed with flat metallic scales, with bristles on front margin only. Mesonotal bristles developed on the sides only. Pro-epimeral and spiracular bristles both present, but few in number (1–3). No sternopleural or lower mesepimeral bristles. Postnotum bare. Male hypopygium: side pieces from 2 to 3 times as long as broad, bearing scales on the dorsal surface, no apical lobes, basal lobes scarcely differentiated, bearing a tuft of spines, beyond which on the inner aspect of the side-piece are two additional spines; clasper simple, curved, with a short, thick, terminal spine. Tenth sternites simple, pointed, bare, with basal enlargement. Parameres small and inconspicuous. Mesosome well chitinised, divided or entire, according to the species. Female abdomen blunt-ended, eighth tergite somewhat bristly. Hind tibiae shorter than the others. Claws all simple, in the male the front pair slightly unequal. No pulvilli. Wings with the fork-cells longer than their stems, the upper somewhat narrowed towards the apex. Tip of sixth vein nearly level with the base of the fork of the fifth, and only slightly beyond the base of the second. Wing-scales pointed. Microtrichia present on membrane of wings.

Larva: Antennae short, without hair-tuft. Head tufts normal in number and position. Metathorax without strong spines. Comb of 8th segment an irregular patch of scales. Air-tube with numerous hair-tufts, on both dorsal and ventral surfaces, and with round-ended, flat, fringed scales similar to those of the 8th segment, arranged in two irregular rows on each side, apparently representing the pecten. No ventral brush on last segment.

The adults are very small dark-coloured mosquitoes with metallic markings; they live in association with ants of the genus *Cremastogaster*, which they solicit for food, obtaining it by inserting the proboscis between the ants' jaws. The larvae live in old water-filled nests of the ants (Jacobson), or in water collected at the bases of wild pineapple leaves (James, Stanton). The remarkable habits of the adults have been described in some detail by Jacobson, Banks,* James and Farquharson.

In spite of the absence of bristles on the postnotum, there can be no doubt that the genus should find a place among the Sabethini, on account of the larval characters, and the head bristles, round-ended scales and short hind tibiae of the adults.

Up to the present the following specific names have been proposed:—

Malaya genurostris Leicester (1908). Kuala Lumpur.
Harpagomyia splendens de Meijere (1909). Java.
Grahamia trichorostris Theobald (1909). Ashanti.
Harpagomyia coeruleovittata Ludlow (1911). Philippine Is.
Harpagomyia taeniarostris Theobald (1911). Uganda.

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* See Theobald 1909 and Muir 1919. I have been unable to trace Banks' work.

As I have previously stated (1913), *splendens* and *coeruleovittata* appear to be synonyms of *genurostris*, almost the only difference observable between specimens from Java and Kuala Lumpur (as also from Ceylon) being in the colour of the thoracic integument, which may perhaps depend on the age of the individual. However, the Philippine species (*H. coeruleovittata*) may be distinct from *H. genurostris*, since Dr. Ludlow describes the clypeus as being "heavily covered with a rather long fine white fuzzy tomentum." This could hardly be said of any of the five species I have examined, in which the clypeus is at most pollinose, distinct "tomentum" not being visible under a magnification of 100.

The two described African species, however, are certainly distinct from one another, and from *H. genurostris*, though the distinction I have given between them (1912) does not hold good, being based on a mixed series. Besides these two, a close study of Mr. Farquharson's material, in comparison with that already existing in the British Museum, has revealed the existence of two more. It is certainly remarkable that there should be apparently only a single species in the geographically discontinuous areas of Ceylon, the Malay Peninsula, Java and the Philippines, while there are four distinct species in Africa; but this is the only conclusion possible from an examination of the available material.

The five species are all very similar; the following diagnoses include all the characters (so far as I could ascertain) which are not common to all of them.

KEY TO THE SPECIES.

Clypeus yellow.	
Eyes separated by a scaled line . .	1. *genurostris* Leic.
Eyes practically touching	2. *taeniarostris* Theo.
Clypeus black.	
Head scales all blackish.	3. *fraseri*, sp. n.
Head scales silvery in front.	
Mesonotum with median silvery line.	4. *trichorostris* Theo.
Mesonotum without such line . .	5. *farquharsoni*, sp. n.

1. **H. genurostris** Leicester. See Plate XVI, fig. 5 × 50.

Clypeus yellow, with a silvery-grey pollinosity. Proboscis (except labella) more or less yellow. Eyes narrowly separated by a silver-scaled line. Head with a patch of bluish-silvery scales in front. Mesonotum with a double median longitudinal row of metallic silvery scales, integument varying in colour from light brown to black. Pro-epimeral scales silvery. Abdomen with lateral patches of silvery scales on segments 2, 4, 5, 6 and 7, those on segments 2 and 4 the largest. Male hypopygium very small, often almost entirely hidden, yellowish in colour. Basal lobe of side piece with two distinct spines and several stiff hairs; side pieces less than twice as long as broad. Lobes of ninth tergite slightly prominent, with about 8 undifferentiated hairs. Mesosome divided.

The British Museum series includes Leicester's type male; 6 ♀ from Batavia, Java (*F. W. Terry*); 1 ♂ 3 ♀ bred from larvae from wild pineapple, Kuala Lumpur (*Dr. A. T. Stanton*); and 2 ♀ 2 ♂ from Colombo, Ceylon (*Col. S. P. James*).

2. **H. taeniarostris** Theobald. See Plate XVI, fig. 6 × 50.

Differs from *H. genurostris* as follows :—

Eyes practically touching, at any rate no scales on the line separating them. Pro-epimeral scales pale golden. Male hypopygium larger, blackish. Spines on basal lobe of side piece and on lobes of ninth sternite more numerous. Aedoeagus rather differently formed.

Besides Theobald's male type from Kampala Swamp, Uganda, the British Museum collection now contains a female from Dar-es-Salaam, E. Africa (*A. W. J. Pomeroy*). The mesonotum in both specimens is very much rubbed, but the female shows traces of the double median row of metallic scales, and this must therefore be presumed to be present in the male also.

3. **H. fraseri,** sp. n. See Plate XVI, fig. 8 × 50.

Clypeus blackish, with very slight grey dusting, rather shorter than in the two preceding species. Proboscis entirely dark. Eyes separated by a very narrow unscaled line. Head scales all blackish. Pro-epimeral scales silvery. Mesonotum with no trace of a double median row of metallic scales, the whole surface being covered with narrow, straight blackish scales; integument black. Abdomen with silvery lateral spots on segments 2, 4, 5, 6 and 7. Male hypopygium rather larger than in the two preceding. Side pieces over twice as long as broad; basal lobes with four or five spines besides a few hairs. Lobes of ninth tergite elongated, with five bristles, of which the apical two are stronger than the others. Mesosome not divided, not very strongly chitinised.

Described from two males in good condition in the British Museum collection from Mpumu Forest, Uganda, July 1910 (*Capt. A. D. Fraser, R.A.M.C.*). The specimens had previously been identified as *H. taeniarostris* Theobald, but are obviously distinct.

4. **H. trichorostris** Theobald. See Plate XVI, fig. 7 × 50.

Differs from *H. fraseri* as follows :—

Eyes distinctly separated by a scaled area on the upper part of the front, touching below. A large patch of metallic silvery scales on head in front. Mesonotum with double median row of metallic scales. Male hypopygium large, prominent, yellowish. Side pieces three times as long as broad, basal lobes with a tuft of about 10 spines. Lobes of ninth tergite elongate, with two strong spines at the tip and one shorter bristle internal to these. Mesosome undivided, strongly chitinised.

Known only from Theobald's type male and female from Obuasi, Ashanti (*Dr. W. M. Graham*).

5. **H. farquharsoni,** sp. n. See Plate XVI, figs. 9–11 × 50 and fig. 12 × 200.

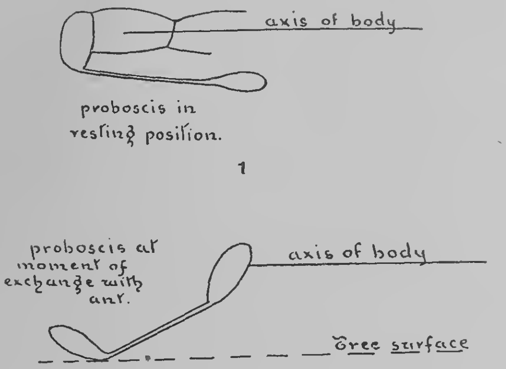
Differs from *H. fraseri* as follows :—

Eyes distinctly separated by a scaled area on the upper part of the front, touching below. A large patch of metallic silvery scales on head in front. Male genitalia small, resembling those of *H. genurostris* except in the structure of the mesosome. Lateral silvery spots on segments 5 and 6 of female abdomen very small.

Six males and five females from Ibadan, S. Nigeria (*C. O. Farquharson*). None are in perfect condition, but none show the metallic thoracic line; two or three metallic scales are present on the front of the mesonotum in one specimen, but these may have been displaced from the prothoracic lobes.

[The material here described was sent by Mr. Farquharson in two consignments, of which the first—1 ♂, 5 ♀—was intended to illustrate the observations recorded in Proc. Ent. Soc., Lond., 1918, pp. xxix–xxxix, and was exhibited to the Society at the next meeting (pp. xxxix, xl). It was erroneously identified by Mr. Farquharson (p. xxxii) and Dr. Guy Marshall (p. xl) as *H. trichorostris* Theo., and also wrongly sexed (p. xl). The examples were captured at a "*Cremastogaster*-tree" at Moor Plantation, near Ibadan, on Dec. 14, 1917, and the ♂ was being fed by an ant received in the same consignment—a worker of *Cremastogaster buchneri*, near *alligatrix*, if not actually this race. Of the 5 ♀, 2 are in the Coll. Brit. Mus.

The second consignment consisted of 5 ♂ (2 in Brit. Mus.) from the same locality, Aug. 10, 1918, accompanied by a sample of the ants which were feeding them. This worker ant was also near the race *alligatrix*. Similar workers were being robbed by the Cecidomyid *Farquharsonia rostrata*, on the same date (pp. 440–42). The ants were kindly compared by Mr. W. C. Crawley and Mr. A. H. Hamm with specimens named by Dr. Forel. The 5 ♀ in the first consignment offer sufficient evidence that this sex as well as the other is fed by the ants. Mr. Donisthorpe tells me that Dr. Jacobson does not mention the sexes of those he observed being fed by ants in Java. Dr. Eltringham has kindly traced and made available for reproduction in text fig. 6, a hurried sketch in Farquharson's letter of Dec. 23, 1917, quoted in Proc. Ent. Soc., 1918, pp. xxxiv–xxxv. The record of so accurate an observer, who had just carefully studied the insects in life, is well worth preserving.—E.B.P.]


axis of body
proboscis in resting position.
proboscis at moment of exchange with ant.
axis of body
tree surface

1

2

Fig. 6.

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EXPLANATION OF PLATE XVI (FIGS. 5–12)

(Facing p. 517.)

FIG. 5. Male hypopygium of *Harpagomyia genurostris* Leic., seen from beneath × 50.

6. Male hypopygium of *Harpagomyia taeniarostris* Theo., seen from beneath × 50.

7. Male hypopygium of *Harpagomyia trichorostris* Theo., seen from beneath × 50.

8. Male hypopygium of *Harpagomyia fraseri*, sp. n., seen from beneath × 50.

9. Side piece of male hypopygium of *H. farquharsoni*, sp. n. × 50.

10. Anal segment and aedoeagus of *H. farquharsoni*, sp. n., from above × 50.

11. Ninth tergite of *H. farquharsoni*, sp. n. × 50.

12. *H. farquharsoni*, sp. n., internal parts further enlarged and flattened out. *a*, Tenth sternites; *b*, basal enlargement of tenth sternites, connecting them with the ninth tergite; *c*, aedoeagus (= unci of Dyar); *d*, small rods lying within the genital tube; *e*, parameres folded back × 200.

XII. *Description of a new Genus and two new Species of Cecidomyidae, and six new Species of Acalyptrate Muscidae* (*Ephydridae and Milichidae*). By J. E. COLLIN.

PLATES XIV, XV, XVI (figs. 1–4), XVII.

CECIDOMYIDAE.

Subfamily :—*CECIDOMYINAE.*

Group :—*CECIDOMYIARIAE* (*DIPLOSARIAE*).

FARQUHARSONIA, gen. n.

Eyes connected for a long distance on upper part of head. Antennae 2 + 12 jointed, the flagellar joints in the male binodose, the two nodes being connected by a narrow neck except on the first flagellar joint, where the neck is indicated by a slight constriction; each node with an apical circlet of looped threads, the loops all about equal in length and barely reaching to the base of the following node, the apical node of each of at least the first ten flagellar joints with, in addition, a basal circlet of inconspicuous pores similar to those on the antennal joints of the female, and like them without looped threads; apical joint with a short cylindrical terminal process. Flagellar joints of female cylindrical and sessile; each with two circlets of inconspicuous pores connected by two longitudinal lines of similar pores. Palpi four-jointed, long and very slender. Proboscis extraordinarily developed, half as long again as head is deep, chiefly composed of the greatly developed paraglossae. Male hypopygium with a conspicuous triangular projection at base of the basal segment of the forceps; apical segment slender and bare with a slightly hooked tip; upper anal lamella triangularly emarginate; lower lamella longer, somewhat battledore-shaped, bearing numerous hairs round the margin, and considerably shorter than the style. Female ovipositor not extensile, terminating in two oval upper, and two very similar lower, lobes. Legs clothed with short adpressed scale-like hairs. All ungues bifid, the lower tooth shorter and more slender than the upper; empodium rudimentary. Wings rather short and broad, auxiliary vein present (more easily distinguished where viewed from beneath). cubital vein slightly down-curved and ending very little below tip of wing.

This genus is easily distinguished by the structure of the mouth-parts. If the presence of an auxiliary vein has not been overlooked in other genera of the *Cecidomyiariae*, it belongs to a group containing only a few genera, of which *Tetradiplosis* Kieff. from Argentina (known in the female sex only) also has bifid ungues, rudimentary empodium and non-extensile ovipositor.

F. rostrata, sp. n. Plates XIV, figs. 1–10; XVI, fig. 1.

♂. Eyes large occupying greater part of head. Frons and face short, brownish, the latter with a few short yellowish hairs on the lower part. Occiput rather puffed out, brownish-black with a fringe of very long curved black hairs, similar hairs being present on the lower part of head beneath the neck. A small ocellar tubercle bearing a pair of very long curved bristles. Antennae about half as long again as head and thorax together. First flagellar joint only constricted about the middle, second joint with a very short neck separating the two nodes, subsequent joints with this neck and the terminal pedicel gradually becoming slightly longer, but even on the penultimate joint they are hardly as long as the node from which they respectively arise; last node with a cylindrical pubescent terminal process devoid of bristles or pores and only a little more than one-third the length of the node; the basal node of each joint appears to bear only a single whorl of bristles, but the apical node in addition to a subapical whorl, bears numerous finer more strongly curved bristly hairs. Mouth-parts remarkably developed, the two valves of the paraglossae being produced into a huge yellow beak; each valve is thin, chitinous, semi-transparent and clothed on the convex, outer (lateral) side with yellowish hairs which become longer on the hinder edge towards the pointed tip. Inside the chamber formed by these two valves are found the much shorter labrum and hypopharynx, the latter with a long slender "tongue"-like organ reaching to the tip of the paraglossae. This "tongue" is hair-like and microscopically pubescent at the tip. Palpi yellow, four-jointed, very long and equally slender, second joint the shortest, the almost equally long first and fourth joints being slightly longer than the third. Head connected to thorax by a long slender membranous neck.

Thorax yellowish, slightly brownish on disc, with two rows of black bristly hairs (some of them very long) gradually converging to form a large V, starting behind each humerus and ending in front of scutellum; other bristly hairs are present above notopleural depression, on postalar calli, and in the form of two rather ill-defined tufts at tip of scutellum. A fringe of similar very long bristly hairs extends from below root of wing to base of middle coxa.

Abdomen rather darker than thorax, clothed dorsally and ventrally and on basal segment of genital forceps with numerous long dark bristly hairs, especially long on hind-margins of segments. Legs yellow, but more or less obscured, especially on tibiae and tarsi, by a clothing of short adpressed scale-like hairs. Coxae, trochanters, and all the femora beneath, with rather long dark hairs. Tarsi very long and slender; ungues very small, bidentate, the lower tooth arising near the base, more slender and shorter than upper tooth; empodium absent or very short.

Wings short and broad, the costal, subcostal, and cubital veins dark, the postical and postical folds much less distinct. Auxiliary vein present but inconspicuous, most easily seen when viewed from underside of wing, this vein bears about three small pores just in front of humeral cross-vein; subcostal vein with two similar pores at its junction with costa; cubital vein with a single pore at cross-vein and two others at about three-quarters of the distance to tip. The curved scale-like hairs on both upper and lower surface of wing point towards the base of wing. Halteres with dusky knobs clothed with narrow adpressed scales.

♀. Resembling the male, but antennae shorter, with the joints all simple, longer than broad, almost sessile, and without the looped hairs of the male; the bristles on these joints do not appear to be arranged in distinct whorls, though there appear to be some stronger bristles at the base of each joint, at least on the upperside. Abdomen terminating in a non-telescopic ovipositor, bearing two pairs of ovate, short-haired papillae.

Length (not including antennae), very variable, from ·5 mm. (some males) to 2 mm. (some females).

[A description, on pp. 439–40, of the abundant material is followed by Farquharson's account of the habits. The species was captured at Agège (152 ft.), 16 m. N. of Lagos, as well as at Moor Plantation, near Ibadan, S. Nigeria. The Cecidomyids fly over the carton nests of *Cremastogaster* ants, and, approaching ants engaged in feeding others, endeavour, while hovering in the air, to abstract a portion of the regurgitated droplet. The ant was *Crem. buchneri* r. *alligatrix* at Agege, and near r. *alligatrix* at Moor Plantation.—E.B.P.]

CHAETODIPLOSIS Kieffer, Bull. Soc. Metz, xxviii, p. 103 (1913).

C. gymnastica, sp. n. Plates XV, figs. 1–8; XVI, figs. 2–4.

♂. Eyes connected for a long distance on upper part of head. Antennae 2 + 12 jointed, exceedingly elongate (quite twice as long as the insect itself) and with all the flagellar joints binodose, the nodes connected by a long narrow neck and the joints by a slightly longer pedicel arising from the distal node. Basal node of each joint globular, distal node more elongate, rather wider at tip than at base and more or less constricted about the middle (more so towards end of antennae); basal node with a circlet of looped threads of almost equal length, distal node with two such circlets; basal node with a circlet of long bristly hairs, distal node with an apical circlet of similar hairs, and in addition (especially beneath) with numerous finer more curved hairs. Apical antennal joint with a terminal appendage of which the basal half is ovate, the apical half cylindrical. Face short, yellowish, bearing a few yellowish hairs on the lower part. Palpi four-jointed, yellow; basal joint short, second and third equal, and each about twice as long as the first, fourth joint the longest, slightly longer than the third. Proboscis somewhat prominent (in a prepared specimen about half as long as head is deep), paraglossae not at all pointed. Ocellar tubercle with two long curved bristles, and other curved bristles on occiput and lower part of head beneath neck as in *Farquharsonia*, but more yellowish. Thorax and abdomen yellowish, or brownish-yellow, with bristly hairs much as in *Farquharsonia* but not so dark in colour. Hypopygium with only a very slight basal projection on inner side of basal segment of forceps, apical segment slender, bare, tip slightly hooked and apparently bifid. Upper anal lamella deeply triangularly emarginate, dividing it into two narrow pointed lobes; lower lamella closely adpressed to style, being also the same width as that organ but not quite so long and rounded at the tip. Legs long and slender, yellowish, but obscured especially on tibiae and tarsi by a clothing of adpressed, brownish, scale-like hairs. All femora with long yellowish hairs beneath. Ungues simple. Empodium very short. Wings longer than in *Farquharsonia* and all the veins yellowish; auxiliary vein present; cubital vein strongly down-curved toward the tip and ending well below apex of wing. Halteres yellow, the knob slightly obscured by a clothing of adpressed, brownish, scale-like hairs.

♀. Resembling the male, but antennae not half so long; the flagellar joints simple and cylindrical, connected by a short but distinct pedicel; each joint with two circlets of minute pores connected by longitudinal lines of similar pores very much as in *Farquharsonia* but the pores smaller and consequently less easily distinguished. The antennae are very distinctly hairy; at the base of each of at least the first ten flagellar joints two or three straight bristly hairs on the upperside are distinctly longer and stronger than any others, the majority of the others being finer, paler, more curved, and especially numerous on the underside of each joint; appendix to apical joint with a few hairs on the ovate basal portion. Abdomen with rather shorter yellow bristly hairs and in addition with numerous very short adpressed, scale-like hairs. Ovipositor membranous, normally telescoped within the abdomen, but capable of very considerable extension, terminating above in two narrow, elongate, club-shaped papillae bearing a few short fine hairs, and beneath with two broadly sessile ovate lobes forming the lower lip of the oviduct.

Length very variable—·5 to 1·5 mm.

[Eight ♂ and 34 ♀ hanging from threads in a hollow in the trunk of *Alstonia*, containing part of the carton nest of *Cremastogaster*, Moor Plantation, S. Nigeria, Aug. 11, 1918. For Farquharson's account of the habits see pp. 442–43.—E.B.P.]

The genus *Chaetodiplosis* was described by Kieffer for the reception of *C. tropica*, a new species from Taveta in British East Africa of which he appears to have seen only a single female specimen with damaged palpi. Farquharson's species seems to agree sufficiently in venation, structure of antennae and ovipositor, as well as in having simple ungues and rudimentary empodium, to be congeneric. Certainly Kieffer described the ovipositor as having "un petit lobe ventral," whereas in *gymnastica* there are two lobes of which the greater part of each is embedded in the membrane of the lower lip of oviduct; also he laid stress upon the antennal joints having "deux verticilles de poils dont *l'inferieur a d'un côte des poils gros, raides et presque deux fois aussi longs* que ceux de l'autre côte," while not mentioning the numerous fine curved hairs which exist beneath each flagellar joint in *gymnastica*. These differences however, do not appear to justify the separation of *gymnastica* generically from *tropica*, especially so long as the male of the latter species remains undiscovered.

A single female specimen of a quite distinct species was found among the numerous specimens of *C. gymnastica* collected by Farquharson as described on p. 442. It is easily distinguished by its straighter cubital vein ending at wing-tip, and the more ovate terminal lobes of ovipositor. In default of further material no attempt has been made to mount and describe this specimen.

EPHYDRIDAE.

RHYNCHOPSILOPA Hendel, Suppl. Ent., II, 96 (1913).

R. apicalis, sp. n.

Frons, thorax and abdomen brightly shining, glassy, with metallic blue and violet reflections. No acrostichal bristles. Tip of wing darkened.

♂ ♀. Face shining yellowish with the projecting (clypeus-like) mouth-edge whitish. Palpi dusky yellow. Arista yellow at least about the base but the hairs dark. Scutellum duller than disc of thorax; upper half of pleurae dusted greyish. Thoracic bristles long, but no acrostichals; one pair of dorso-centrals at middle of thorax very long with 2–3 smaller somewhat incurved pairs in front decreasing in length as they approach front of thorax, and one pair (shorter than middle pair) behind, half-way towards scutellum; a humeral, two notopleural, an up-curved posthumeral, two intra-alar (the hinder one very long), a small supra-alar, and two postalar bristles. Abdomen with long bristly hairs especially on the 3rd–5th segments. Front coxae, all tibiae, and tarsi except last 1–2 joints, yellow; rest of legs varying from yellowish-brown to black. Wings with the tip (including the end of the cubital and discal veins) darkened, and with a darkened patch on all the veins across the base of wing, opposite (and including) the humeral cross-vein. Halteres white with a dusky base to stem.

Length about 2 mm.

[Farquharson's material included 2 ♂ 3 ♀ examples of this species, captured between Dec. 25, 1917 and Jan. 26, 1918, at Moor Plantation, nr. Ibadan, S. Nigeria. They were feeding from the anus of dead *Cremastogaster* ants as described in Proc. Ent. Soc., 1918, pp. xxxv, xxxvi, xl. An observation made by Farquharson at a later date (see pp. 443–44) clearly shows that *R. apicalis* pursues the living ants with the same object.—E.B.P.]

The genus *Rhynchopsilopa* was distinguished from *Psilopa* Fallén by Hendel by reason of its long antennae, with the first joint porrect, second and third drooping, third 3–4 times as long as wide, and pubescent. Only one fronto-orbital bristle and that pointing forwards. Mouth-edge projecting in front. Palpi projecting slightly beyond mouth-edge and bristly at tip. Proboscis geniculate, the middle part long, the small paraglossae bent backwards.

The type-species, *R. magnicornis* from Formosa, is stated to have a distinct bristle at end of second antennal joint directed forwards, palpi dull black, arista black, only one pair of dorso-central bristles with a row of fine hairs in front, acrostichals present ending in a pair of prescutellar bristles.

Another species, *R. rugosiscutata* Meij. from Java, appears to agree with *magnicornis* in having only one pair of dorso-central bristles, but the frontal triangle is dull black, and the scutellum and greater part of pleurae is "runzelig und dadurch ziemlich matt." It agrees more with *apicalis* in having only a very weak bristle at end of second antennal joint pointing forwards.

Neither *magnicornis* nor *rugosiscutata* have a darkened tip to wing.

MILICHIDAE.

Milichia Meigen, Syst. Beschr., vi, 131 (1830).

The following species all belong to the genus *Milichia* as at present restricted, though they differ considerably from the type species (*speciosa*). The bare mesopleurae appear to keep them out of the genus *Rhynchomilichia*, which they approach in the structure of the proboscis. The species described below as *M. farquharsoni* is the most aberrant in chaetotactic as well as other characters. It is considered advisable to retain them all in the genus *Milichia* until a better knowledge of the group has been attained.

1. **M. argyratoides**, sp. n. Plate XVII, fig. 1.

Dull, dark brown species. Abdomen of male almost entirely silvery. Only two parts of dorso-central and fronto-orbital bristles. Face exceedingly short. Third antennal joint darkened.

♂. Head and thorax dull dark brown. Frons wide, at vertex quite five times as wide as third antennal joint is deep, and widening out slightly towards antennae. Frontal lunule with a pair of distinct bristles on the upper margin. Only two frontal bristles on each side of upper third of frons, the hinder one pointing backwards, the front one forwards, on rest of frons only a single row of very short incurved hairs each side and very short scattered hairs on disc. Face exceedingly short, the mouth-opening curving upwards almost to the tip of frontal lunule, leaving narrow cheeks each side which join the very narrow jowls below the eyes. A short black vibrissal bristle followed by 2–3 others, becoming shorter and finer as they approach and merge into the black hairs on lower part of back of head. Eyes microscopically pubescent. Antennae short, third joint dark brown, slightly yellowish in some lights, with a long, very distinctly pubescent, arista. Palpi very large, dilated in the shape of an equilateral triangle with rounded corners and slightly rounded sides; they are dark yellowish-brown and clothed with very short, fine, dark pubescence. Proboscis hidden between the palpi. Thorax rather greyish on humeri and right in front; front part of meso- and sterno-pleurae olive brown with a tendency to appear greyish in some lights. Disc covered with very short black hairs which leave three exceedingly narrow lines down the thorax, bare. Two pairs of dorso-central bristles, the front pair much the weaker, placed close to the hind pair and a little nearer the mid line of thorax; a strong central prescutellar pair of bristles, a humeral, a posthumeral, two notopleural, and three supra-alar bristles placed in a straight line parallel with a line joining the two strong bristles on postalar callus; four scutellar bristles with the middle pair cruciate; a tiny prothoracic bristle immediately above the base of front coxa and the usual three sternopleural bristles; mesopleura bare. Abdomen only a little broader than thorax, the long 2nd segment and the 3rd–5th segments entirely silvery-grey dorsally as in *speciosa*. Legs the colour of thorax but posterior knees very narrowly yellowish. Wings hyaline except at base as far as humeral and basal cross-veins; end of subcostal vein distinctly, and small (discal) cross-vein slightly, darkened; this latter cross-vein placed at $\frac{1}{3}$, or very slightly more, from base of discal cell; cross-vein closing discal cell sloping so that lower outer angle of cell is acute. Last portion of discal vein slightly shorter than penultimate portion and almost parallel with cubital vein. Squamae and halteres dark.

♀. Resembling the male except that the abdomen is entirely dull, dark brown and bears more numerous short black hairs. Frons slightly wider at vertex and more parallel-sided.

Length 4 mm. One pair.

[The specimens arrived in a pill-box bearing the date

(? of emergence) Sept. 10, 1915, and the locality Mamu (Gambari), in the Shagamu district about 20 miles S. of Ibadan. They were bred on the road from larvae in an exuding wound in the bark of a *Cremastogaster* ant-tree. Notes on the life-history and habits of the larvae will be found on pp. 444–45.—E.B.P.]

M. argyratoides appears closely to resemble *M. argyrata* Hendel from Formosa, which was described as belonging to the *speciosa*-group and presumably differs in having the face long, as in that species. Hendel's species also has only one pair of dorso-central bristles, while the male abdomen is twice as wide as the thorax, and the third and fourth (cubital and discal) veins slightly converge towards tip of wing.

2. **M. proectes**, sp. n.

Resembling *M. argyratoides*, but thorax rather lighter olive-brown. Abdomen with silvery patches at sides only. Antennae with yellowish third joint.

♂. Head in profile very much like that of *argyratoides* but the palpi are not so prominent and are wider at the base, while the row of bristles from vibrissal angle along the mouth-edge are longer and stronger. Face very short but distance from end point of frontal lunule to mouth-edge a little less than third antennal joint is deep. Frontal lunule with a pair of small bristles. Palpi a paler yellowish brown. In the type the paraglossae of proboscis project beyond the palpi as diverging pointed lobes bearing a few black hairs. Thoracic chaetotaxy as in *argyratoides*. Abdomen the same colour as thorax and rather narrower; viewed in some lights the sides of the first four segments are silvery, spreading very narrowly across the front margin of the third and fourth segments; front margin of fifth segment very narrowly silvery at sides. Viewed directly from behind these silvery patches appear dull black. Venter with at least the broad third and fourth tergites silvery in some lights. Legs with the front as well as the posterior knees very narrowly pale, the femora in some lights appearing silvery beneath. Wings faintly tinged with brown, the small (discal) cross-vein rather further from base of cell, last portion of discal vein rather shorter than penultimate portion and almost parallel with cubital; lower outer angle of discal cell rather acute.

Length 3·75 mm.

A single male.

[The specimen formed part of the material, captured at

Moor Plantation, near Ibadan, S. Nigeria, Dec. 23, 1917, to Jan. 26, 1918, and sent to illustrate Farquharson's observations on *Milichia* published in Proc. Ent. Soc., 1918, pp. xxxiii, xxxiv, xl, where it is shown that these flies solicit and receive regurgitated food from ants in the track running up the trunk of "*Cremastogaster*-ant-trees."—E.B.P.]

3. **M. prosaetes,** sp. n. Plate XVII, figs. 2 and 3.

Smaller and more shining than the previous two species. Abdomen distinctly shining and without silvery patches. Frons much narrower in male. Vibrissal angle more projecting.

♂. Frons only about twice as wide as third antennal joint is deep, dull brown, but varying from almost black to dull greyish brown according to the point of view. Frontal lunule with a pair of distinct bristles. Face very short, no longer than third antennal joint is deep. Both face and frontal lunule appearing silvery from some points of view. Vibrissal angle more projecting and the cheeks between face and eyes wider. A single vibrissa followed by a rather widely spaced row of short bristly hairs towards back of head. Palpi dark brown or reddish brown and pubescent, dilated leaf-like, but of a more even width throughout instead of being triangular as in the previous species. The long, very pointed, slightly hairy paraglossae of proboscis may project straight out between palpi, or be bent back and point towards prothoracic sternum. Antennae with third joint reddish brown, arista shorter than in the previous species and only microscopically pubescent. Thorax rather shining, dark brownish black; pleurae and hind part of disc in front of scutellum dusted greyish. Chaetotaxy as in *argyratoides* except that middle bristle of the three supra-alar bristles is not in a line with other two but placed rather higher up on disc. Abdomen very distinctly shining and blacker than thorax, the black hairs short and not very numerous. Tergites extremely narrow on first three segments, widening out into a triangle on fourth, and still wider on fifth, segment. Legs with the knee joints very narrowly, and the joints of coxae and trochanters indistinctly yellowish, hind femora at base with a long, fine, postero-ventral, bristly hair. Wings short and rather broad, faintly tinged with brown and distinctly brownish along the costa from humeral cross-vein to end of subcostal vein. Cross-vein closing discal cell not so sloping as in *proectes;* last portion of discal vein about two-thirds length of penultimate portion and slightly diverging from cubital vein. Squamae and halteres dark, the latter with a yellowish base to stem.

♀. Resembling the male but frons nearly twice as wide and very faintly shining. Abdominal tergites of more equal width throughout.

Length barely 3 mm.

One male and five females.

[Two specimens, a ♂ and ♀, formed part of the material captured at Moor Plantation, near Ibadan, S. Nigeria, Dec. 23, 1917, to Jan. 26, 1918, and sent to illustrate Farquharson's notes in Proc. Ent. Soc., 1918, pp. xxxiii, xxxiv, xl. The remaining 4 ♀♀ were captured in the same locality, in May, 1918, on the evidence of a letter of May 28 (see p. 445). They formed part of a set of "absolutely guaranteed mendicants" (pp. 445–46), soliciting food from *Cremastogaster* ants.—E.B.P.]

4. **M. dectes,** sp. n.

Closely resembling *M. prosaetes* but wings without the brown streak along costa at base of wing, and thorax and abdomen more densely pubescent.

♂. Frons nearly double as wide as in *prosaetes* ♂ and with the bristles (especially ocellar and vertical) longer. Thorax blacker, without the slight brownish tinge of *prosaetes* and with more numerous short hairs; notopleural depression and disc of scutellum with a greyish tinge in some lights; supra-alar bristles almost in a straight line. Abdomen with a distinct greyish tinge about the base of the second segment except at the sides; the short black hairs with which the abdomen is clothed very much more numerous. Tergites of moderate width throughout. Wings without any indication of the brownish costal streak of *prosaetes*.

♀. Resembling the male, frons only slightly wider than in *prosaetes* ♀. The greyish tinge about the base of second abdominal segment not so conspicuous as in the male. Slightly smaller than *prosaetes*.

Two males and four females.

[A single ♀ formed part of the material of Dec. 23, 1917 to Jan. 26, 1918, and the remaining 2 ♂, 3 ♀ a part of the series of "absolutely guaranteed mendicants," as described under *M. prosaetes*.—E.B.P.]

5. **M. farquharsoni,** sp. n. Plate XVII, figs. 4–6.

Superficially somewhat resembling the two previous species, but with the second antennal joint longer, a proboscis of remarkable structure, and different thoracic chaetotaxy and costal lobe.

♀. Head rather wider than thorax. Eyes microscopically pubescent. Frons almost a third the width of head, parallel-sided, brownish, and dull on the broad central stripe and at vertex, more greyish and slightly shining on the narrow orbits next to eye-margin. Chaetotaxy as in other species. Frontal lunule small, shining, the usual pair of bristles very short and fine. Face only slightly narrower than frons, longer than in any of the other species, flat and dull greyish. Cheeks rather distinct, of almost equal width throughout and merging into the jowls which become very narrow at lower margin of eyes. No distinct vibrissae—only a row of short fine hairs. Antennae placed very close together at base, first joint very short, indistinguishable on the outer side but visible as a ridge on the inner and lower sides; second joint long, dull brownish black, almost as long as the third joint which is rounded in outline and strongly compressed laterally; inner side of second and third joints clothed with a curious soft fine curved pubescence; third joint yellowish brown at least about the base. Arista microscopically pubescent, second joint long. Palpi greyish brown, of almost equal width throughout and laterally compressed, closely approximating at the upper mouth-margin and then widely diverging, this diverging portion being somewhat concave on the inner side; the margin of this concave part and the whole of the lower side of the palpi clothed with similar soft fine curved pubescence as on inner side of antennae. Proboscis geniculate, the basal part much flattened, bare on the central part but clothed with short dark hairs at the sides, terminal part (paraglossae) of a curious shape, compressed laterally and bearing on the upperside towards tip some remarkable long bristly hairs.

Thorax rather dull brown with an aeneous tinge; pleurae dusted greyish. Chaetotaxy as in the other species except for the absence of the posthumeral, supra-alar (as distinct from postalar) and central prescutellar, bristles. Abdomen brilliantly shining black except on the first segment and a large dull greyish patch occupying the greater part of disc of second, and (to a rather less extent) of third segment; the moderately short black hairs, scattered, not very numerous, and more upright on fifth segment.

Legs black with the tip of anterior tibiae and all tarsi (except for the last joint or two) yellowish, but the front tibiae are brownish yellow on basal part, and the hind tarsi are rather brownish on the basal joint. Hind tibiae with a rather sinuous antero-dorsal ridge, behind which is a flattened and slightly concave space, brilliantly shining, with violet reflections, down which runs a single row of short black bristles. Wings with a faint yellowish tinge and yellow veins. End of subcostal vein sharply marked black, emphasised by the fact that the costa just before the break at this point is produced into a black lobe. Small (discal) cross-vein opposite end of subcostal vein, ends of cubital and discal veins distinctly converging, and last portion of latter vein distinctly longer than penultimate portion. Squamae dusky with pale brown fringes. Halteres black with brownish-yellow stems.

Length barely 3 mm.

Five females.

[All the specimens formed part of a set of "absolutely guaranteed haunting flies," captured in May, 1918, on the evidence of a letter of May 28 (see p. 445), at Moor Plantation, S. Nigeria. These flies were haunting the carton nest of *Cremastogaster* ants as described on pp. 445–46. They were not seen to receive food from the ants like the other species here described.—E.B.P.]

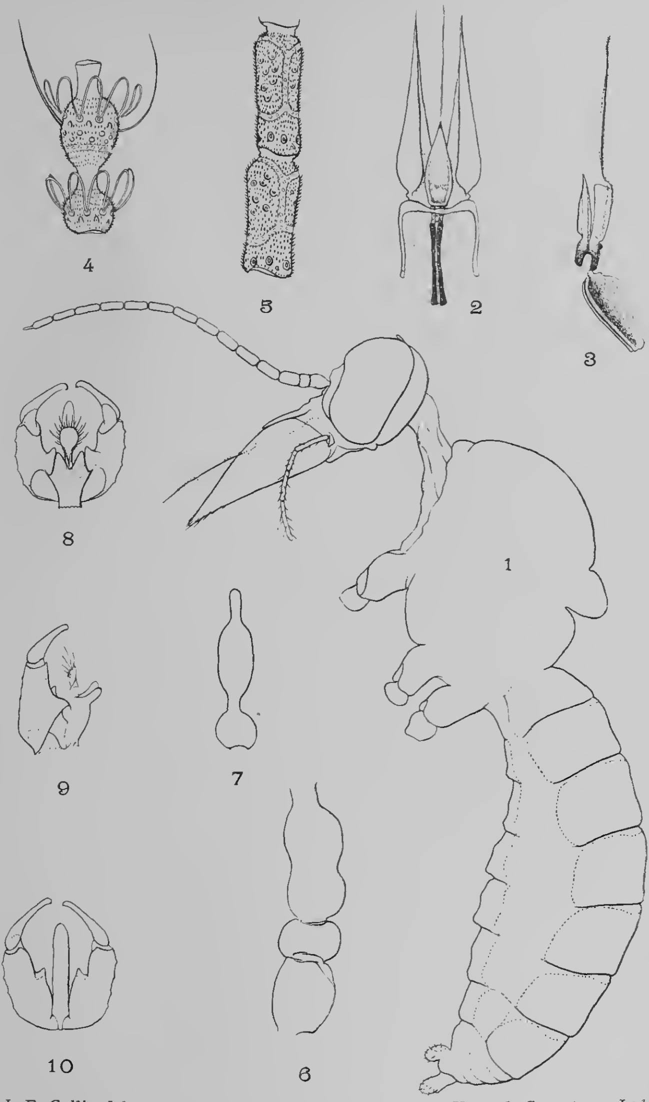
EXPLANATION OF PLATE XIV.

PLATE XIV.

Farquharsonia rostrata, sp. n.

FIG. 1. Outline of female × 33.
2. Mouth-parts of female from in front × 40.
3. Side view of labrum, hypopharynx, etc. × 40.
4. One of the middle joints of male antennal flagellum, much enlarged. (Only one of the straight and one of the curved bristles figured.)
5. One of the middle joints of female antennal flagellum, much enlarged. (No bristles figured.)
6. Outline of first three joints of male antenna, much enlarged.
7. Outline of terminal antennal joint of male, much enlarged.
8. Hypopygium of male from above × 60
9. Hypopygium of male from right side × 60.
10. Hypopygium of male from beneath × 60.

} Bristles on basal joint of forceps not figured.



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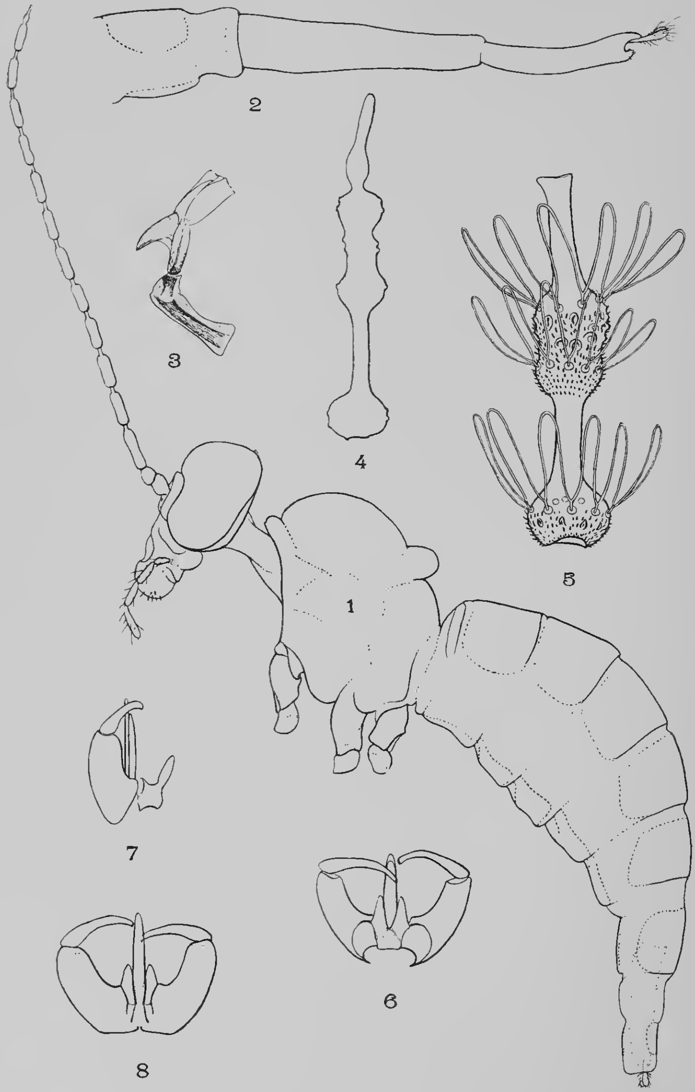
FARQUHARSONIA ROSTRATA, A S. NIGERIAN CECIDOMYID.



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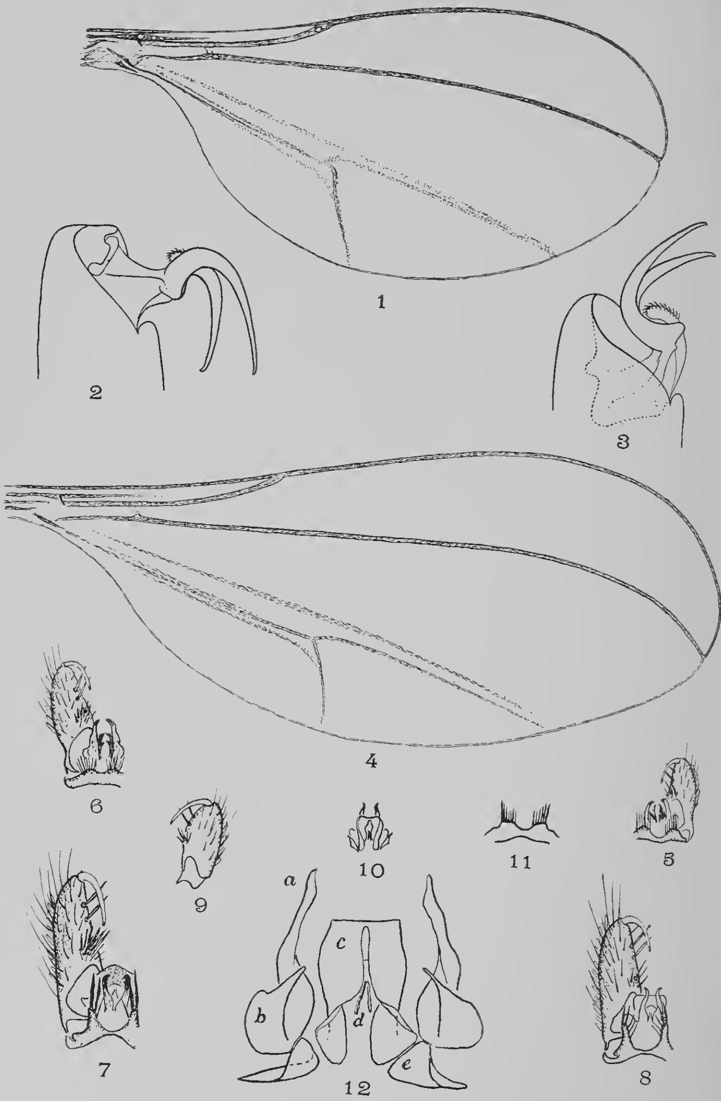
CHAETODIPLOSIS GYMNASTICA, A S. NIGERIAN CECIDOMYID.



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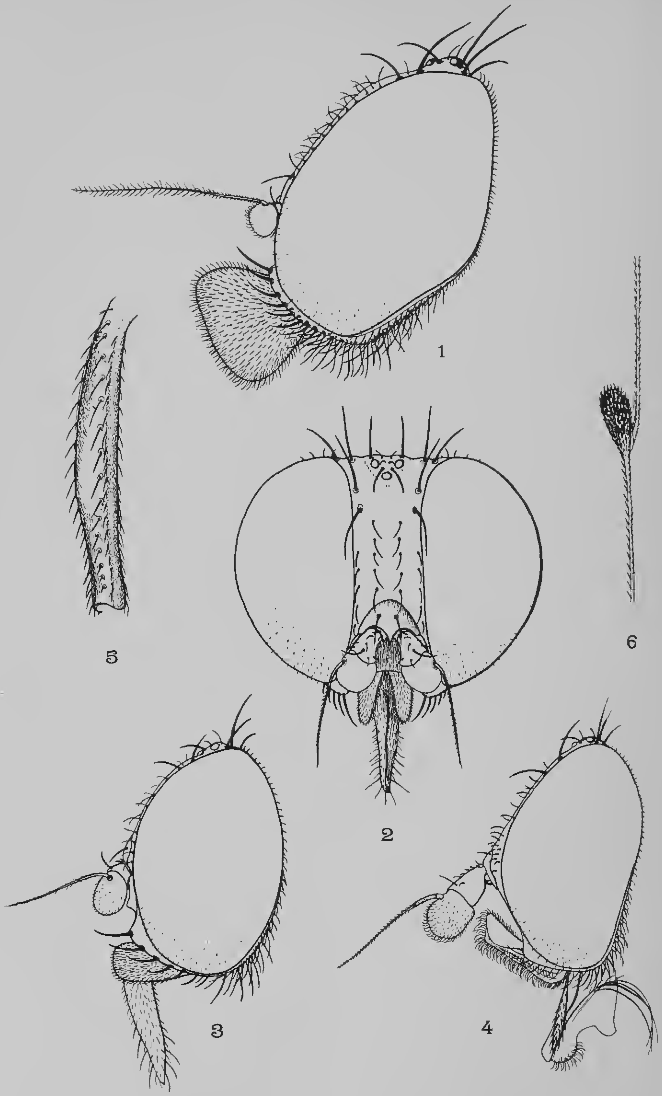
FARQUHARSONIA (1), CHAETODIPLOSIS (2–4), AND HARPAGOMYIA (5–12).



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S. NIGERIAN SPECIES OF MILICHIA (Diptera).

EXPLANATION OF PLATES XV, XVI (Figs. 1–4), XVII.

PLATE XV.

Chaetodiplosis gymnastica, sp. n.

FIG. 1. Outline of female × 33.
2. Female ovipositor extended × 40.
3. Side vein of labrum, hypopharynx, etc. × 60.
4. Outline of terminal antennal joint of ♂, much enlarged.
5. One of the middle joints of male antennal flagellum, much enlarged. (No bristles figured.)
6. Hypopygium of male from above × 60.
7. Hypopygium of male from right side × 60.
8. Hypopygium of male from beneath × 60.

} Bristles on basal joint of forceps not figured.

PLATE XVI (Figs. 1–4).

FIG. 1. *Farquharsonia rostrata.* Wing venation × 33.
2. *Chaetodiplosis gymnastica.* Ungues extended, much enlarged.
3. ,, ,, Ungues at rest, the base withdrawn into the end of the tarsal joint as indicated by the dotted lines, much enlarged.
4. ,, ,, Wing venation × 33.

(For explanation of figs. 5–12, illustrating Mr. F. W. Edwards' paper, see p. 503.)

PLATE XVII.

FIG. 1. *Milichia argyratoides* ♂. Profile of head × 23.
2. ,, *prosaetes* ♂. Front view of head × 23.
3. ,, ,, ♀. Profile of head × 23.
4. ,, *farquharsoni* ♀. Profile of head × 23.
5. ,, ,, ♀. Left hind tibia from above × 33.
6. ,, ,, ♀. Costa at end of mediastinal vein viewed from front edge of left wing × 33.

XIII. *Descriptions de six Tachinides nouveaux d'Afrique.*

Par le Dr. J. Villeneuve.

1. **Exorista poultoni**, n. sp.

♂. D'un noir brillant, oblong. Epaules et tête à enduit gris jaunissant et mat; péristome ardoisé; thorax à légère pruinosité grise en avant, sur laquelle apparaît l'origine de trois fines lignes noires médianes, distantes; scutellum largement rougeâtre au bord libre; abdomen rougeâtre sur les flancs des segments II et III. Antennes allongées, un peu plus courtes que le clypéus, noires ainsi que les palpes qui sont assez épais au bout. Pattes noires, à griffes antérieures longues. Ailes hyalines, jaunies à la base; cuillerons amples, jaune d'œuf; balanciers à massue obscure.

Vertex large comme 2/5 d'œil. Une seule soie verticale; soies ocellaires aussi développées que les 2 paires de soies frontales ascendantes; 4 soies descendant sur les gênes jusqu'au niveau du chète antennaire, celui-ci ayant le 1^er^ article distinct, le 2^e^ nettement allongé, le 3^e^ épaissi dans sa première moitié. Occiput sombre, avec quelques rares cils en arrière des cils rétrooculaires. Péristome à peine large comme le vertex. Yeux à longue pilosité blanchâtre.

Thorax: 4 soies dorsocentrales; 2 + 2 soies sternopleurales.

Scutellum: 4 soies longues, de chaque côté; les apicales croisées.

Abdomen: 1^er^ segment excavé à fond; segments I et II ayant 2 soies marginales médianes, courtes et plutôt faibles, III et IV avec une rangée complète de soies longues et robustes. Pas de soies discales sur les 3 premiers tergites.

Pattes: tibias postérieurs à cils fins et à peu près réguliers, mêlés d'une longue soie médiane.

Ailes: 3^e^ nervure portant 2 cils à son origine; coude de la nervure IV presque à angle droit; transverse apicale modérément arquée; transverse postérieure oblique, à peine sinueuse. Pas d'épine costale.

Taille: 8 millim.

[The unique type bears the label "ex Pterocarpus Lycaenid." It was bred at Moor Plantation, near Ibadan, in March, 1917, probably from *Deudorix diyllus*, p. 382.—E.B.P.]

2. **Hilarella helva**, n. sp.

Port et taille de *H. stictica* Meig., mais d'un jaune chamois clair sur l'abdomen qui ne présente ni taches noires latéro-dorsales ni taches latérales, seulement une bande grisâtre médio-dorsale sur laquelle tranchent les pores largement auréolés de noir profond des 2 macrochètes médians; thorax et scutellum d'un gris jaunissant uniforme, de même sur les gênes, tandis que le front est un peu doré. Palpes jaunes. Cuillerons ocracés. Pattes brunes, à tibias testacés.

[The unique type was bred on June 20, 1915, from a Noctuid larva, the prey of *Ammophila beniniensis*, as described on pp. 426–27. Locality: Moor Plantation, near Ibadan.—E.B.P.]

3. **Tricyclea evanida**, n. sp.

♀. De taille moyenne, entièrement d'un jaune pâle à l'exception: (1) d'une large bande cendrée sur le thorax où elle occupe l'espace compris entre les soies dorsocentrales, en le débordant un peu; (2) du mésophragme entièrement noir; (3) d'une bande noire postérieure sur les segments abdominaux II et III, bande assez large qui donne un prolongement médian triangulaire n'atteignant pas le segment précédent et qui s'amincit vers les flancs pour devenir étroite sous le ventre. Le dernier segment est marqué à ses 2 angles postérieurs d'une tache noire transversale.

L'occiput, noirâtre et plus ou moins poudré de gris, est assez largement bordé de jaune derrière les cils retrooculaires. Ces cils s'arrêtent, en bas, au niveau du bord inférieur des yeux et, de là, s'étendent sur la partie supérieure du péristome. Ailleurs, le péristome est couvert de poils blancs, sauf à l'angle postérieur où quelques longs poils noirs font suite aux soies du bord inférieur.

Les palpes sont dilatés au bout en raquette.

Ailes hyalines, sans épine costale et sans aucune tache noire; cuillerons et balanciers presque blanchâtres.

4 soies dorsocentrales. 3ᵉ tergite abdominal avec une rangée complète de soies marginales parfois couchées; 4ᵉ tergite avec quelques soies disco-latérales qui sont dressées ainsi que la rangée des soies apicales: toutes ces soies sont développées.

Taille: 7–8 millim.

Plusieurs femelles de la Nigeria, de l'Ouganda et de la Côte-d'Or.

[A single *evanida* was found by Dr. Villeneuve among 5 ♀ Tricycleas bred by Farquharson in October or early November, 1917, from larvae referred to in the following note:—

"*Dec.* 12, 1917.—Another tube contains some other Dipterous larvae of which imagines are sent. These feed on the débris that is piled up round the nest openings of the ant *Paltothyreus.* The little mounds were simply heaving with these maggots. I was only able to breed out a few before I went travelling." [See p. 436.]

Of the remaining 4 ♀ bred from Farquharson's larvae Dr. Villeneuve wrote Apr. 9, 1920 :—

" Les 4 premiers exemplaires sont *T. exarsa,* bien pareils au type de Brauer-Bergenstamm, qui est encore chez moi, et au type de Guérin-Méneville de la collection Macquart, étiqueté aussi '*exarsa* W.' et qui est aussi chez moi."

Concerning the ♂ of *T. evanida* and *exarsa*, Dr. Villeneuve wrote, also on Apr. 9, 1920 :—

" Le ♂ ayant une bande brune le long de la moitié distale de la nervure II de l'aile, n'appartient pas certainement à *T. evanida*, mais est très probablement un ♂ de *T. exarsa* B.-B. IMMATURE. J'ai trouvé le vrai ♂ de *T. evanida* ; son aile est pareille à celle de la ♀, c'est à dire sans aucune tache ni bande."

Inasmuch as nothing is known (Proc. Ent. Soc., 1914, p. v) of the life-history of *Tricyclea*, v.d. Wulp (=*Zonochroa* B.-B.) it is very satisfactory to know that the larvae of *T. evanida* and *exarsa* have been found in the débris of *Paltothyreus tarsatus*, and that the three following new species have been seen to oviposit in and round the nest openings of Driver ants (*Dorylus*).—E.B.P.]

4. **Tricyclea semithoracica**, n. sp.

♂♀. De taille moyenne ou plus petite, d'un jaunâtre terne, à l'exception : (1) d'un espace noirâtre occupant la partie comprise entre les soies intraalaires, depuis la suture jusqu'au scutellum; ce rectangle noir est parfois étroitement échaneré au milieu de son bord antérieur; (2) du mésophragme noirâtre; (3) des dessins noirs des tergites abdominaux, à savoir : une bande étroite de chaque côté du tergite I, sur son tiers externe—une bande plus large, complète, élargie en triangle à sa partie médiane jusqu'à rejoindre le tergite précédent, distingue le tergite II—les tergites III et IV sont presque entièrement noirs, le premier n'ayant plus de jaune que les angles antérieurs et le second qu'une tache médiane apicale.

L'occiput est noirâtre entièrement; les cils noirs rétrooculaires descendent jusqu'aux soies du péristome qui est lui-même couvert de poils noirs épars.

Palpes en massue.

Ailes à deux taches noires le long du bord antérieur, l'une occupant la cellule médiastinale et la débordant jusqu'à joindre la nervure II, l'autre tache allongée et entourant l'extrémité de cette nervure.

L'espace clair qui les sépare est à peu près de la longueur de la tache médiastinale. Au-delà de la nervure II, le rebord costal de l'aile est étroitement ombré, davantage à l'extrémité de la 1ere cellule postérieure. Cuillerons à peine ocracés; balanciers jaunâtres.

4 soies dorsocentrales—les 2 derniers tergites abdominaux bordés de soies raides, espacées et peu longues; les soies disco-latérales du tergite IV débiles.

Le ♂ a les yeux joints, à facettes ordinaires.

Taille: 6–7 millim.

Je connais cette espèce de la Nigeria et de la Côte-d'Or. [W. A. Lamborn's material, submitted to Dr. Villeneuve, included 4 ♀ of this species, observed on Dec. 10, 1913, to be dropping their ova into and between the openings of a temporary nest being constructed by Driver ants (*Dorylus*) at Moor Plantation, near Ibadan, S. Nigeria, as described in Proc. Ent. Soc., 1914, pp. v–vii. Farquharson had directed Lamborn's attention to the ants and thus prompted the observation.—E.B.P.]

5. **Tricyclea verticella**, n. sp.

♂♀. Jaune, ayant le thorax entièrement noir en dessus, à l'exception des épaules et d'une étroite bande latérale qui restent jaunes jusque près de l'insertion des ailes; pleures maculés de noirâtre. Scutellum largement noir à sa base. Abdomen légèrement brillant; les tergites ont chacun une bande marginale noire: étroite et largement interrompue sur le segment I, large et complète sur les segments II et III où elle s'amincit un peu latéralement, réduite à 2 taches apicales sur le segment IV.

Le mésophragme et l'occiput sont entièrement noirs; la même coloration s'étend sur le vertex et couvre fréquemment la moitié postérieure du front.

La disposition des cils rétrooculaires et la vestiture du péristome sont comme dans l'espèce précédente; les palpes sont également en massue.

Les ailes, un peu sales, ont une tache noire occupant toute la cellule médiastinale et reposant sur la nervure II, puis, séparée de la première par un court espace clair, une autre tache brune, très allongée, enveloppant l'extrémité de la nervure II et continuée par une zone ombrée plus claire le long de la côte jusqu'à la terminaison de la 1ere cellule postérieure. Cuillerons sales; balanciers testacés.

Les pattes ont l'extrémité distale des fémurs postérieurs et les tibias correspondants plus rembrunis que dans la plupart des espèces du genre *Tricyclea*.

Normalement, 3 soies dorsocentrales développées; entre la 1ère et la 2e, une soie plus courte et plus faible est interposée. Les soies marginales du tergite abdominal III sont courtes et couchées, mais robustes et longues latéralement; celles du dernier tergite sont développées, tandis que ses soies disco-latérales sont courtes ou débiles.

Le ♂ a les yeux joints, à facettes ordinaires.

Taille : 5–7 millim.

Nombreux individus de la Nigeria, un de l'Ouganda et un du Congo belge.

[A single ♀ of *T. verticella* was found by Dr. Villeneuve in Lamborn's material illustrating the observations summarised under *T. semithoracica.*—E.B.P.]

6. **Tricyclea perpendicularis**, n.sp.

♀. Cette espèce est comme intermédiaire entre les deux précédentes. De *T. verticella*, elle a le scutellum à large tache basale noire, l'abdomen de même coloration et à soies identiques. Comme chez *T. semithoracica*, les ailes hyalines ont 2 taches noires et disposées de la même manière; les pleures sont pâles avec la seule tache noire habituelle, l'hypopleurale; le thorax montre tout le tergum d'un gris bleuté en arrière de la suture, avec cette différence qu'il s'en détache une bande médiane de même couleur qui s'avance dans l'espace compris entre les soies acrosticales présuturales; la tête, enfin, est la même.

Palpes en massue—4 soies dorsocentrales.

Taille : 5–6 millim.

2 ♀ de la Nigeria méridionale.

[A single ♀ of this species also was found by Dr. Villeneuve in the material which contained *verticella* and *semithoracica.* All three species therefore are known to be attracted to Driver ants and to drop their eggs into and between the funnel-shaped openings of a temporary nest. The ants did not appear to notice the eggs, " but in the natural course of their work gradually covered them with earth." (Proc. Ent. Soc., 1914, p. vi.) This material had been submitted to Major Austen, who separated the three species exactly as Dr. Villeneuve has done.

Two other Diptera also ovipositing, although in a different manner, among the Driver ants on the same occasion (*ibid.*, p. vii) were also submitted to Dr. Villeneuve who has kindly written the following note, also confirming, and in *Rhinia* carrying somewhat further, Major Austen's conclusions.

" Quant à *Rhinia apicalis* Wied., vera, c'est la variété avec une tache obscure à l'extrémité de l'aile. Ici, c'est la variété '*testacea R.D.*, 1830' : l'aile et l'abdomen n'ont aucune tache noire sur votre specimen.

" L'Anthomyide paraît être du genre *Limnophora ;* il est en trop mauvais état pour être déterminé."—E.B.P.]

XIV. *Description of a peculiar unidentified Dipterous Larva possessing a number of enigmatic truncate Abdominal Organs.* By J. Bronté Gatenby, D.Phil., D.Sc., Professor of Zoology, Trinity College, Dublin, Senior Demy, Magdalen College, Oxon.

Plate XVIII.

Among the material sent to Prof. E. B. Poulton by Mr. C. O. Farquharson was a small unidentified larva believed to be a Syrphid. Cursory examination of this larva showed that it possessed, on the ventral surface of the last third part of its body, a number of peculiar tubes arranged in two bunches set side by side. The ultimate region of the abdomen was found to bear a tracheal funnel, in somewhat the same manner as the larva of *Eristalis tenax*. In the unidentified larva, however, the funnel did not seem to be extrusible and extensile as in the rat-tailed Syrphid larvae. In Plate XVIII, fig. I, the larva is drawn to the centimetre scale given above. In front were two processes, short and with few joints, which were the antennae; the mouth-parts did not appear to be abnormal. From 1*a* to 6*a* in this figure were six pairs of processes surmounted by numbers of hooklets as in the *Eristalis* larva. Behind the last pair of leg-processes were found the truncate organs already mentioned (Plate XVIII, fig. I, Tu). In fig. II the organs on one side are drawn at a higher power. Each one was seen to have at its extremity a minute pore. Just behind the region of the truncate organs the body tapered sharply, but before passing on to the tracheal funnel it gave rise to two lateral, backwardly directed obtuse processes (PR in fig. I).

The entire surface of the larva was covered with raised processes or rugosities, and the epidermis was markedly thick and pigmented towards the hind regions, somewhat like the *Eristalis* larva. Nothing of special interest was found in connection with the nervous or alimentary system, but the latter was of the complicated type found in many Dipterous larvae. The anus opened in the region of the truncate organs between the two bunches, so that the trunk-like tubes are really peri-anal. The two lateral tracheal tubes open behind at TT in fig. I. There are no lateral stigmata, but there is apparently a pair in the head region as in the *Eristalis* larva.

The hind regions of this larva were sectioned in order to examine the truncate tubes. In Plate XVIII, fig. IV, there is drawn a transverse section of the body in the region of the tubes; one of the latter is cut in longitudinal section, while two others, at DP, are just in the section. In fig. IV it will be noticed that the tube is hollow, from the pore upwards, to the place marked by the legend Tip. At this region the main tube is seen to be folded again to form an inner tube; to the inner tube are fixed some muscle bands at M; these are attached to the body-wall of the larva in the region of the tubes. Inspection of fig. IV at once shows that each tube is really arranged so as to be eversible by pressure of the fluid of the body, and the muscle at M functions in redrawing the tube when once everted. In fig. V the tube is diagrammatically represented as half everted, the tip (Tip in fig. IV) being now outside; in fig. VI the eversion is complete. The attachment of muscle is at MA.

It was found that the hypoderm cells of the truncate tubes were very large and glandular.

Probable Function of Eversible Truncate Organs.—In fig. III is a diagrammatic drawing of a larva with its tracheal funnel above water taking in air; the eversible organs are shown protruded to their fullest extremity. There seems little doubt that these organs, connected as they are with the haemocoel, and everted by haemocoelic fluid pressure, serve as additional respiratory organs, when the larva is in water too deep to enable it to use its tracheal funnel. A less likely suggestion might be that the organs are used for climbing and adhering to water-weeds.

Systematic Position of Larva.—Until the fly is bred from this larva, it will be impossible correctly to place it in its position, but in arrangement of legs, in the appearance of the integument, in the shape of the body, and in the tracheal apparatus, this larva shows undoubted affinities with the form *Eristalis*.

[The following extracts from Farquharson's letters confirm Prof. Gatenby's suggestion that the protrusible processes are respiratory in function.—E.B.P.]

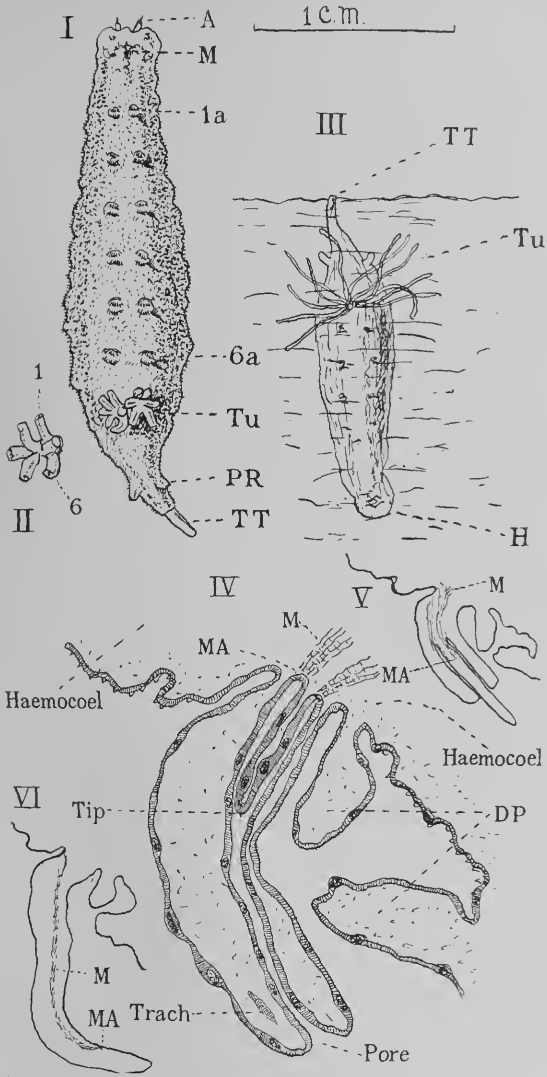
Dec. 12, 1917.—You will remember my telling you of the (?) Syrphid larva with the curious protrusible process, that I found in the decaying banana leaves in water. I have failed to breed out the imago so far, but hope to have another try. The specimen sent shows the organ—a fusion, I think, of a pair—extruded, but much contracted in the spirit. In life it was quite transparent with branched silvery lines running out to the tips of the fingers or lobes. These I believe to be tracheae. I will send more larvae when I can get them.

Aug. 11, 1918.—I am sorry that I overlooked those Syrphid larvae. I will place "baits" of pieces of cut banana stem in putrid water for them, and, if I get any started, I shall try to leave them with Dr. Connal to complete the life-history if they do not pupate before I go. I thought that the white "line," running out into each lobe of the curious organ, was a trachea or branch of one, as I think I mentioned at the time. The organ shrinks in spirit, but in life it was a very pretty structure, the lobes being quite translucent with the silvery white line running out to the end of each. The whole organ can be withdrawn out of sight inside the body of the larva. I think I will manage to fix that little problem up all right.

Note (*October 1921*).—Prof. E. B. Poulton, whom I have to thank both for the opportunity of examining this material, and for encouraging interest during the work, has drawn my attention to Mr. Farquharson's reference to "silvery lines" running down the tubes. These lines I think must be the muscles marked M in fig. VI, and not tracheae, as one might naturally expect.—J. B. G.

PLATE XVIII.

[*For Explanation of Figs.* I–VI *see accompanying text.*]



J. B. Gatenby del.

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A S. NIGERIAN AQUATIC DIPTEROUS LARVA
(? Syrphidae).

E. THYSANOPTERA.

XV. *Notes on Selenothrips rubrocinctus Giard, taken by C. O. Farquharson on a Forest Tree at Agege, near Lagos.* By R. S. Bagnall, F.R.S.E., F.L.S.

Selenothrips rubrocinctus Giard.

Physopus rubrocincta Giard, 1901.
Heliothrips rubrocinctus Franklin, 1908.

This species is a great pest of Cacao in the West Indies and is also known from Ceylon. It was described fully by Franklin in 1908. Its specific name is due to the broad band of bright red (almost crimson) hypodermal pigmentation running across the base of the abdomen in the larva. At a later date Karny wrote upon his conception of the divisions of the genus *Heliothrips* (Revision der Gattung *Heliothrips* Haliday in Entom. Rundschau, Jahrb. 28, No. 23, pp. 179–182) and diagnosed the subgenus *Selenothrips* for the reception of *rubrocinctus*, and a new and closely allied form, *S. decolor* Karny, found on Cacao in New Guinea.

The presence of *S. rubrocinctus* on the W. Coast of Africa is particularly interesting in view of the fact that I have only recently received a supply of the other species, *S. decolor*, from the Gold Coast, where it is injurious to Cacao. *S. decolor* is most readily separated from *rubrocinctus* by the absence of the red hypodermal pigmentation at the base of the larval abdomen. There are also minute structural differences in the antennae.

[The specimens on which Mr. Bagnall's note was written were preserved in spirit. The following note accompanied them: "Rather large Thrips from bush tree at Agege. Immature forms run about with drop of dark liquid at posterior end.—Oct., 1917."—E.B.P.]

F. HOMOPTERA.

XVI. *A new Southern Nigerian Aleurodes* (*Aleurodidae*).

By Prof. R. Newstead, F.R.S.

Plate XIX, facing p. 531, Fig. 1.

Aleurodes africanus, sp. n.

Pupa Case (fig. 1*a*). Flat, broadly ovate, segmentation distinct; dorsum very finely rugose, the rugosities very narrowly separated by extremely fine striae arranged somewhat radially; anal furrow distinct. Fringe or other secretionary matter absent. Colour dark brown or black with a broad, clearly defined, translucent margin; stigmatic clefts and anal furrow dusky white and clearly defined; vasiform orifice pale yellow. Margin (fig. 1*b*) very faintly crenulated and with fine but well-marked sutures or striae. Dorsal pores (fig. 1*c*) small, forming an irregular series just within the striated border. Eye-spots (fig. 1*d*) small. Vasiform orifice (fig. 1*e*) somewhat subcordate; the operculum filling a little more than half the orifice; lingula, when fully extended, projecting almost to the distal margin of the orifice, densely setose and furnished with a pair of short spinose hairs arising from a subapical collar of chitin. Stigmatic clefts (fig. 1*f*) well defined, terminating with three short, dactyliform processes. Anal cleft (fig. 1*g*) with two pairs of processes; the distal pair similar to the corresponding ones in the stigmatic clefts; the proximal pair somewhat triangular.

Length, 1·2–1·3 mm.; width, 1·1–1·2 mm.

Larva, second instar. Narrowly ovate; margin similar to that of the pupa case. Vasiform orifice with the operculum transversely elliptic and not quite extending to the middle distance, central area of the distal edge very finely spinose; lingula as in the pupa. Anal furrow distinct, distal angles each with a slender spinose hair; there is also a similar spinose hair at the margin considerably in advance of them.

Length, 0·6–0·7 mm.

W. Africa: S. Nigeria, Moor Plantation, nr. Ibadan, May, 1917. C. O. Farquharson.

[The *Aleurodes*, attached to the under surface of the leaves of *Salacia* sp. (*Celastraceae*), in Farquharson's compound, formed the food of the carnivorous Noctuid (*Erastriinae*) larva of *Eublemma scitula* (pp. 407–408.—E.B.P.]

The pupa-case of this insect does not agree in all its details with any of the new genera erected by Quintance and Barker.* I have therefore placed it in the genus *Aleurodes*, from which it differs, however, in having the "submarginal area" faintly separated from the "dorsal disk" and also in its form and colour.

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* Classification of the Aleurodidae, U.S. Dept. Agr. Tec. Ser. No. 27, Pt. ii (1914.)

XVII. *A new Southern Nigerian Lecanium* (*Coccidae*).

By Prof. R. NEWSTEAD, F.R.S.

PLATE XIX, Fig. 2.

Lecanium (Saissetia) farquharsoni, sp. n.

Female adult. Form hemispherical, or narrowly ovate and highly convex; margin very thick, forming a distinct rounded moulding or bead. Integument with a faintly matted surface when preserved in alcohol, due apparently to secretion or foreign matter, on the removal of which, by slight friction, the derm presents a polished appearance. Colour rich dark castaneous; immature examples dusky buff. Antennae of eight segments; the 3rd equal to or a little longer than the 2nd. Legs robust; anterior pair with an unusually long bristle on the trochanter; tarsus inclusive of the claw about equal in length to the tibia. Anal lobes (fig. 2*a*) forming together a distinctly pyriform outline, the distal margin being about half the length of the lateral and markedly rounded; distance from distal margin of the lobe to the anal margin of body one-fourth the entire length of the body. Anal cleft fused. Stigmatic clefts obsolete; spines three or four in number. Marginal spines (fig. 2*b*) of varying lengths and irregularly disposed, some of them more than twice the length of the longest stigmatic spines; some of them are quite simple; others are slightly frayed distally. Derm cells irregularly ovate closely packed together. Collectively they produce a reticulated pattern at the margins.

Length, 4–4·25 mm.; width, 3·50 mm.

Young adult ♀. Form more or less circular or broadly ovate with the front slightly narrowed or produced; dorsum low convex or more or less flat. Colour dusky buff or pale ochreous. Antennae (fig. 2*c*) of eight segments, the 3rd slightly the longest. Stigmatic clefts faintly indicated, spines (fig. 2*e*) similar to those in the old adult. Derm cells at the margin as in the mature examples, but much less pronounced in the central area. Anal cleft not completely fused, and placed in the same position relatively to the margin of the body, as in the old adult.

In the nymphs or second stage ♀ the anal cleft is not fused.

W. AFRICA: S. Nigeria, Moor Plantation, Dec. 1917. C. O. Farquharson.

[The Coccidae were found on a plant of *Imbricaria maxima* (*Sapotaceae*) and formed the food of a carnivor-

Trans. Ent. Soc. Lond., 1921, Plate XIX.

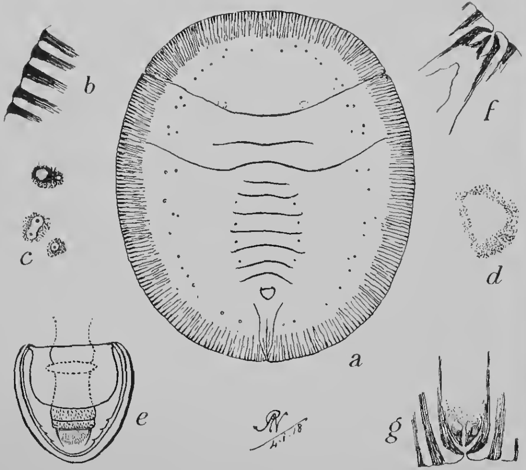

FIG. 1.

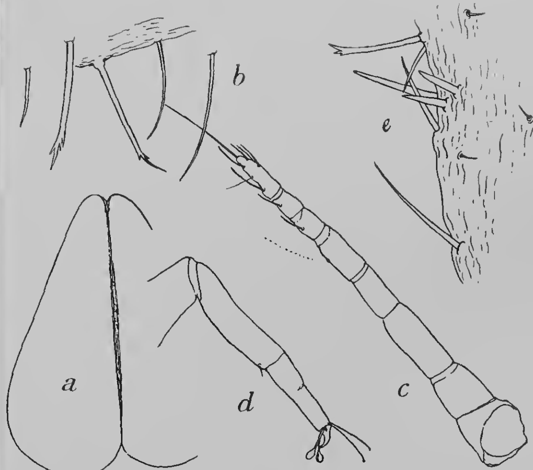

FIG. 2.

Vaus & Crampton, Ltd.

Fig. 1.—ALEURODES AFRICANA Newst.

Fig. 2.—LECANIUM (SAISSETIA) FARQUHARSONI Newst.

ous Lycaenid larva, *Triclema lamias* (p. 387). See also Proc. Ent. Soc., 1918, p. xxx.—E.B.P.]

In its general external facies this insect is inseparable from *Lecanium* (*Saissetia*) *somereni* Newst.,* but the anal lobes and marginal spines in *L. farquharsoni* are markedly different. In its structural details it is much more closely related to *L. catori* Green,† but the anal lobes are placed much nearer the margin of the body than in the last-named species; some of the marginal spines are distinctly though finely divided, laterally, towards the tips, and the longest stigmatic spines are shorter than the longest marginal ones.

* Mitteil. Zool. Mus. Berlin, V, pt. 2, p. 162, fig. 5 (1911). Bull. Ent. Res., Vol. IV, p. 76.

† Bull. Ent. Res., Vol. VI, p. 43, fig. 1 (1915).

EXPLANATION OF PLATE XIX.

FIG. 1. *Aleurodes africanus* Newst.: *a*, pupa case; *b*, margin; *c*, dorsal pores; *d*, eye-spot; *e*, vasiform orifice; *f*, stigmatic cleft; *g*, anal cleft.

2. *Lecanium* (*Saissetia*) *farquharsoni* Newst.: ♀ adult: *a*, anal lobes; *b*, marginal spines. ♀ young adult: *c*, antennae; *d*, anterior legs; *e*, stigmatic spines: (*a*, *c* and *d* to the same magnification).

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Proc. R.I., 1915,
pp. 372–379.

ROYAL INSTITUTION OF GREAT BRITAIN.

WEEKLY EVENING MEETING.

Friday, March 5. 1915.

THE RIGHT HON. LORD RAYLEIGH, O.M. P.C. D.C.L.
LL.D. F.R.S., in the Chair.

PROFESSOR E. B. POULTON, M.A. LL.D. D.Sc. F.R.S. M.R.I.

Mimicry and Butterflies.

SUPERFICIAL resemblances between distantly related butterflies had been pointed out by Boisduval in 1836, long before Bates read his classical paper on mimicry before the Linnean Society, on November 21, 1861. Dealing with South American resemblances, and especially with the examples he had observed in the valley of the Amazons, Bates suggested the well-known hypothesis of the advantageous likeness of a rare and palatable "mimic" for some conspicuous and abundant "model" inhabiting the same locality. In a few years Bates' conclusions were supported by A. R. Wallace, writing upon the butterflies of the Oriental region (1866), and by Roland Trimen, upon those of Africa (1870).

It is important to remember that Bates, in his original memoir, spoke also of other likenesses between butterflies which he did not attempt to explain by his hypothesis of mimicry, viz. the local resemblances between conspicuous species belonging to different groups. Such resemblances between the models themselves also strongly attracted the attention of Fritz Müller, a great German naturalist resident in Brazil – so strongly indeed as to prevent him from accepting Bates' hypothesis as an explanation of wide application among butterflies. The great majority of the superficial likenesses between his Brazilian butterflies belonging to different groups were clearly not to be interpreted by the mimicry of Bates, for of this majority *all* were abundant, conspicuous, slow-flying, and

Mimicry, or Common Warning Colours

presumably protected by taste, smell, or some special quality which rendered them unpleasant or unwholesome as food. Bates had suggested that such a likeness between models was due to some influence, presumably physical or chemical, connected with locality; but this interpretation did not satisfy Fritz Müller. For many years he puzzled over the subject, testing various ideas, as, for instance, the possible operation of sexual selection, throwing out the suggestion in his correspondence with Charles Darwin, that butterflies in the choice of their mates were influenced by the appearance of other butterflies in the same locality. Concerning this bold hypothesis, Darwin wrote, January 23, 1872, to Prof. Meldola:

"You will also see in this letter a strange speculation, which I should not dare to publish, about the appreciation of certain colours being developed in those species which frequently behold other forms similarly ornamented. I do not feel at all sure that this view is as incredible as it may at first appear. Similar ideas have passed through my mind when considering the dull colours of all the organisms which inhabit dull-coloured regions, such as Patagonia and the Galapagos Islands."

It was, however, impossible to accept sexual selection as a valid explanation of the facts, because in a large proportion of mimicking species, the resemblance was confined to the female. On the other hand, there were hardly any species in which the male but not the female was a mimic. At the same time many facts disproved Bates' suggestion that physical or chemical forces were responsible for the likeness between models. Finally, in 1878,* sixteen years after the publication of Bates' memoir, Fritz Müller hit upon an explanation with which he was satisfied. The idea evidently came to him quite suddenly, for he begins his first little paper on the subject: "It is remarkable how one sometimes puzzles for years over questions the solution of which is so simple, that one can hardly understand how there could have been even a momentary difficulty over them."

Fritz Müller's interpretation of what has since been known as "Müllerian Mimicry," depends on the saving of life during the education of insect enemies. When two warning patterns are different, they must be learned and remembered separately, and the two species that bear them must separately endure the necessary waste of life or mutilation. When two patterns are similar the two species share the waste between them, instead of each suffering it independently. Thus "Müllerian Mimicry" is not mimicry at all in Bates' sense. It is rather "common warning colours," or "synaposematic resemblance." The mimicry of Bates has been defined, on the same system of terminology, as "false warning colours," or "pseudaposematic resemblance."

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* Zool. Anzeiger (Carus), i. (1878), pp. 54, 55.

That these two kinds of mimicry exist is admitted by nearly all naturalists who have paid attention to the subject, but there is much difference of opinion as to their relative extent and as to the position of particular examples in the category of Bates or the category of Müller. On these subjects there has been much controversy, Dixey and Poulton upholding the relative importance of Müllerian and Guy Marshall supporting the predominance of Batesian Mimicry.

In this controversy attention has been devoted to two lines of evidence. (1) Diaposematic Resemblance, or "Reciprocal Mimicry," originally suggested, but not worked out in detail, by Fritz Müller, and chiefly developed in later years by Dixey. Controversy has here turned upon the correct interpretation of the patterns believed to have originated in reciprocal mimicry. (2) Secondary Mimicry, or the mimicry of a mimic, rather than of the primary model.

In the meantime, increase in our knowledge has been progressing at a rapid rate, especially in Africa, where English naturalists, following the example of Roland Trimen, have been working at these problems for many years. We owe nearly all our recent knowledge to nine naturalists working in various parts of the continent:—G. D. Hale Carpenter, on the islands and shores of the north-west Victoria Nyanza; W. A. Lamborn, in the Lagos and Ibadan districts of Southern Nigeria; G. F. Leigh, in the Durban district of Natal; G. A. K. Marshall, in Natal and in S. Rhodesia; the late A. D. Millar, in the Durban district; S. A. Neave, in N. Rhodesia, Katanga, B.C. Africa, German and British E. Africa, and Uganda; Rev. K. St. Aubyn Rogers, in British E. Africa; C. F. M. Swynnerton, in S.E. Rhodesia; C. A. Wiggins, in the Entebbe district of Uganda. Nearly the whole of the results bearing on the theory of mimicry, discovered by these naturalists, will be found in the Transactions and Proceedings of the Entomological Society of London.

While this work has been going on in the field, three museums at home have been engaged upon the material supplied—the British Museum of Natural History, the Hope Department of the Oxford University Museum, and the Tring Zoological Museum.

It is only possible in a single lecture, and that rigidly limited to one hour, to direct attention to some of the most striking results that have been obtained.

Roland Trimen originally showed, in 1870, that a swallow-tailed butterfly, *Papilio dardanus* (*merope*), represented in Madagascar by a form (*meriones*) with a female like itself, possessed on the mainland of Africa females entirely unlike the male, and mimicking three different distasteful Danaine butterflies. These different forms and others have now been bred from known female parents by G. F. Leigh, W. A. Lamborn, G. D. H. Carpenter, and C. F. M. Swynnerton.

G. A. K. Marshall, in 1902, suggested that two East African Nymphaline butterflies, with male and female alike (*Hypolimnas wahlbergi* and *H. mima*), mimicking respectively two Danaine butterflies with very different patterns (*Amauris niavius dominicanus* and *A. echeria*) were only two forms of a single species. Both have now been bred from the same female parent by A. D. Millar (recently confirmed in Natal by E. E. Platt), while the corresponding forms of the West have been bred again and again in a very extensive series of experiments by W. A. Lamborn. In these breedings, as well as in the experiments on *Papilio dardanus*, a Mendelian relationship between the mimetic forms was indicated by the results obtained.

Dr. Karl Jordan, of the Tring Zoological Museum, extended the above results into a wide generalization as to the relationship between models and mimics. By accurate and detailed anatomical investigations he proved that it is common, in all tropical countries that are rich in butterfly life, for two or more distinct species with different patterns to be resembled by the different forms of a single mimicking species. The most striking example in which he proved this relationship to exist, belonged to the African Nymphaline genus *Pseudacræa*. A number of *Pseudacræas*, supposed to be species, were found on the West Coast, mimicking large *Acræas* of the genus *Planema*; other different *Pseudacræa* mimics of *Planemas* occurred in Uganda; another in British East Africa; another in Natal. Dr. Jordan discovered that all these mimetic forms were anatomically inseparable, thus reaching the conclusion that all the *Pseudacræas* of this group were the mimetic forms of a single species described by Linnæus from the West coast as *P. eurytus*. The startling nature of this result becomes manifest when we remember that one of these forms in Uganda has a male very different from its female, while two other forms in the same locality have the sexes alike. It was, therefore, of the utmost importance to test the inference from anatomy by the method of breeding. The late A. D. Millar had successfully bred the Natal species, but this being of a single form, although with some of the females unlike their males, did not serve as a test. Finally, however, in 1912 and 1913, G. D. H. Carpenter succeeded in breeding several families from known parents. This work, carried on in Bugalla, one of the Sesse Islands in the N.W. of the Victoria Nyanza, conclusively proved that Dr. Jordan was entirely correct in his conclusions.

Another line of investigation which has been extensively pursued in recent years is the geographical distribution of both models and mimics, together with changes that are found in various parts of the range. A good example is furnished by these same *Pseudacræas* in Uganda. The commonest form in the Entebbe district, as shown by the prolonged researches of C. A. Wiggins, has been known as *P. hobleyi*, with its male mimicking the male of *Planema macarista*, as well as both sexes of *P. poggei*, its female, originally described as *Pseudacræa tirikensis*, mimicking the female of *Planema macarista*. C. A. Wiggins' splendid material at Oxford shows that a very small proportion of the females of *Pseudacræa hobleyi* resemble their males and mimic the same models as these latter. Now as we pass eastward round the northern shores of the Victoria Nyanza, *Planema macarista*, far commoner than *P. poggei* at Entebbe, becomes rarer and apparently ceases on the western side of the Nile, issuing from the lake at the Rippon Falls, near Jinga. *P. poggei*, on the other hand, continues much farther eastward, to Mount Elgon and beyond it to the north-eastern corner of the lake, and probably farther into British East Africa. In correspondence with this distribution S. A. Neave found that the male-like female of *Pseudacræa hobleyi* becomes the predominant form east of the Nile. On the other hand, the female form *tirikensis*, resembling the female of *Planema macarista*, is predominant where, as at Entebbe, its model is common.

Another interesting geographical change is witnessed when we compare C. A. Wiggins' experience at Entebbe with G. D. H. Carpenter's in Damba and Bugalla Islands in the lake. At Entebbe the above-mentioned *Pseudacræa hobleyi*, with sexes nearly always unlike, is accompanied by two other mimetic forms with sexes alike, all three, as we know from Carpenter's researches, belonging to the same species. These are *terra*, mimicking *Planema tellus*, and *obscura*, mimicking *P. paragea*. At Entebbe the total number of these forms together is shown by Wiggins' investigations to be about one-third of their *Planema* models. On the two islands the proportions are very different, the models being greatly outnumbered by their mimics. On Bugalla, indeed, where the chief captures were made, the *Planemas* were not much over one-third of the *Pseudacræas*. We do not know the cause of this difference: it may be due to difference in the abundance of the food-plants or in some other condition. Corresponding with this reversal in the proportions, the mimetic forms, which are on the whole constant and sharply separated on the mainland, tend to vary and to run into each other on the two islands. The mimicry keeps true where the models are relatively abundant, but often tends to become blurred where they are relatively scarce. It must also be borne in mind that even on the mainland the *Pseudacræas* are far commoner than we should expect them to be, on the hypothesis of Bates.

Passing from Entebbe to the westward, other interesting changes are seen in both models and mimics. It has been explained that in the Entebbe district, the male of one chief model, *Planema macarista*, is mimicked by the male of *Pseudacræa hobleyi*. Both are dark butterflies, with an orange bar crossing the forewing and a white bar the hind. In a forest in western Uganda, S. A. Neave found the male of another species of *Planema* with both bars orange. In the same forest the male *Pseudacræa* had both bars orange, as had also two other mimics, which at Entebbe resembled the male *macarista*—viz. the female *Acræa alciope* and the male *Acræa althoffi*. Two examples of this last male were collected by S. A. Neave, and they are unlike any form of the species that has been seen hitherto; but as regards the other two mimics similar forms are known to occur, although in very small proportions, to the north-west of the Victoria Nyanza.

The geographical changes of the female *Acræa alciope* in relation to its models, may be considered in fuller detail. The female at

Entebbe with orange and white bars, is so unlike its non-mimetic male that it was always regarded as a distinct species, until a few years ago the true relationship was made out by H. Eltringham. On the west coast the female is less unlike its male, and has for long been recognized as belonging to the same species. The fine collections made by W. A. Lamborn in the Lagos district shows that the female *alciope* here mimics two or three species of *Planema*, but especially the males of *P. alcinoe.* The orange bar of the forewing is narrower and duskier in tint than in Eastern Uganda, while the hind wing is also dusky orange, fringed with dark grey-brown, almost black. There is considerable variation, as shown by very large numbers of families bred by W. A. Lamborn. The non-mimetic male, on the other hand, is very constant and almost precisely like the equally constant male in Uganda.

The great tropical forest of Africa stretches from the west coast to the western borders of Uganda, and here, in the Semliki Valley, a small but intensely interesting collection was made by S. A. Neave. The western model of the female *alciope* continues right over the whole area, but instead of being one of the commonest *Planemas*, it becomes in Uganda relatively rare, and instead of having its influence strengthened by the presence of other species with a similar pattern, it is accompanied in Uganda by the far more abundant white-barred *Planemas*, *macarista* and *poggei.* This change appears to begin about at the Semliki Valley, and it is precisely here that many of the females of *alciope* exhibit faint traces, especially upon the under surface, of the white bar that becomes so conspicuous a feature in eastern Uganda. Not a single specimen with a strongly marked bar was collected by Neave in the Semliki Valley, and it is, therefore, impossible to regard these intermediate females as hybrids between the western and the Entebbe forms of female. The transitional geographical area where the white-barred *Planemas* begin to appear, yields the transitional females—the steps by which these mimics transfer their allegiance from the males of the *Planema alcinoe* type to that of the male *P. macarista.*

It is impossible to regard the resemblance of an *Acræa* like *A. alciope* or *A. althoffi* for a *Planema*, also belonging to the specially protected *Acræinæ*, as anything but examples of Müllerian Mimicry, or Common Warning Colours; and this conclusion is even more obvious when the rarer species of *Planema* assume the patterns of other *Planemas* when they enter the areas where these predominate.

The final illustrations, taken from the genus *Charaxes*, introduce a novel aspect of butterfly mimicry: for both models and mimics are regarded by C F. M. Swynnerton, who has observed and experimented with birds and their insect prey for many years, as among the most palatable of insects. Yet there can be no doubt about the fact that the large species of *Charaxes* are mimicked by the smaller ones, and that some of the larger species mimic each other. Mimicry in the African *Charaxes* has been chiefly studied by Dr. Karl Jordan. who has most kindly suggested many of the examples that have been used as illustrations. These resemblances have also been observed in the field by G. A. K. Marshall, C. F. M. Swynnerton, Rev. K. St. Aubyn Rogers, and S. A. Neave, who also recognized a particularly striking example in the collection made by C. A. Wiggins in the north-east corner of the Victoria Nyanza. Nevertheless, in spite of this general recognition, very little has been published or exhibited on the subject.

The genus *Charaxes* is confined to Africa and the adjacent islands, its place being taken in the Oriental and Australian regions by the closely allied genus *Eulepis*, in which, however, mimetic resemblances have not been recognized. The butterflies are strongly built and extremely powerful in flight, the thorax containing the wing-muscles being specially capacious. They are strongly attracted by fruit, exuding sap, and putrid substances, becoming after a time almost entirely engrossed in their food, although up to this point remarkably alert. C. F. M. Swynnerton informs me that before alighting to feed they will fly backwards and forwards about the spot, displaying the upper surface of the wings: and that when they have alighted they will sometimes open their wings with a snap when disturbed, although a more usual response is to move the hind wings in such a manner as to display conspicuously the "tails" and exhibit the "eye spot" which, in many species, is found on the under surface of the fore-wing where it is normally covered by the hind, when the wings are held upright over the back in the attitude of rest. The meaning of these movements, diverting attention from the vital parts to the borders of the wings, is rendered clear by the frequency with which injuries are found in these positions.

When a *Charaxes* is seized its great strength enables it to struggle violently, and the effect is almost certainly intensified, in the larger species, by the serrated front edge, or costa, of the fore wing. In addition to this "fighting weight," Swynnerton finds that their chitinous exo-skeleton is so tough that an insectivorous bird will often abandon a *Charaxes* after spending perhaps twenty minutes in the vain attempt to remove the wings. Repeated observations have convinced him that, with alertness and power of flight, fighting weight and toughness of integument, *Charaxes*, in spite of its palatability, gives to its smaller enemies such an unpleasant experience that they will tend to avoid a repetition of it, except under stress of hunger, and that on this account the mimetic resemblance is advantageous. It should be added that the behaviour of large and powerful insectivorous birds shows that *Charaxes* is undoubtedly palatable. Furthermore, Swynnerton finds that the thorax, after removal of its integument, is much appreciated by the smaller birds.

Mimicry in *Charaxes* is confined to the upper surface of the wings, and is principally, although by no means exclusively, manifested by the females. It would be inappropriate to draw up a list of species on the present occasion, but reference must be made to the wonderful example of *C. etheocles*, of which some females mimic the males, others the females, others again both males and females, of larger species. In spite of all this mimicry, *etheocles* is one of the most abundant species in Africa, and its non-mimetic male is itself mimicked by a still smaller, and probably weaker, species on Ruwenzori. These facts, as well as the mimetic approach between the larger species that are mimicked by the smaller, are evidence that the resemblance is an advantageous advertisement of protective qualities held in common, although in different degrees, by models and mimics—that it is Synaposematic or Müllerian Mimicry.

[E. B. P.]

Section D.—Birmingham, 1913.] [British Association.

Report, p. 519.

Mimicry between the Genera of certain African Nymphaline Butterflies. By Professor E. B. Poulton, *F.R.S.*

Although the models for butterfly mimicry in the Old World commonly belong to the great distasteful sub-families, the *Danainæ* and *Acræinæ*, they are also to be found among the groups in which we are accustomed to look for mimics rather than models. This is certainly true of the *Nymphalinæ*, in which the mimicry on both under and upper surface of the blue species of *Crenis* by *Crenidomimas* is as remarkable as any known example of such resemblances. The largest number of such instances, however, have been very little spoken of in works on mimicry, although recognised by Aurivillius. I refer to the mimicry of the species of *Catuna*, with both sexes alike, by the females of species of the allied genera *Euryphene*, *Diestogyna*, and *Cynandra*. The resemblance has another characteristic of mimicry in general, viz., the development of secondary resemblances between the mimics. Thus the likeness between the females of *Cynandra opis* and a *Diestogyna*, collected by Mr. S. A. Neave in Uganda, is positively startling. I have always hesitated to draw attention to these examples of mimicry until I knew more about the habits of models and mimics, but within quite recent years Mr. W. A. Lamborn, to whom I owe so much, has observed in the Lagos District that the mimics actually fly in the company of their models. Examples of models and mimics taken in one sweep of the net by Mr. Lamborn and others on which special observations have been made by him are exhibited to the Section.

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XXV. Pseudacraea eurytus hobleyi, *Neave, its forms and its models on Bugalla Island, Lake Victoria, with other members of the same combination.* By G. D. HALE CARPENTER, D.M., Oxon., Member of the Royal Society's Sleeping-sickness Commission.

[Read November 5th, 1913.]

PLATES XXXIV–XXXVI.

THE following is a complete account of all the forms of *Pseudacraea eurytus hobleyi*, their *Planema* models, and other mimics in the same group, which I caught on Bugalla Island in 1912 and January–February, 1913. I wish, firstly, to express my indebtedness to Prof. Poulton for the great help he has given me in the preparation of this paper, especially in the preparation of the plates, the arrangement of which is entirely due to him. It seemed best to publish the results in tabular form, in spite of the greater bulk of such a paper, because by such means a graphic representation of the numerical differences between models and mimics is brought home to the reader as he sees the long array of blank spaces under the headings of the models.

I have taken the opportunity of figuring, on Plate XXXIV, some of the most interesting transitional forms of *Ps. eurytus hobleyi* from Bugalla Island, and of showing the close relationship of a single female (fig. 11) to a typical West African female of *eurytus*, L., from the Lagos district, represented in fig. 12, with its model *Planema epaea*, Cram., in fig. 13.

On Plate XXXV I have figured three of the most interesting of the families of *Ps. eurytus hobleyi* bred from known female parents captured on Bugalla Island. An account of two of the families, B and E (figs. 1–8), together with other synepigonic groups from the same locality, has already been published in these Transactions (1912, pp. 706–16). The third family, J (figs. 9–16), is recorded in Proc. Ent. Soc. 1913, pp. ix–xi. These breeding experiments conclusively prove that all the forms of *eurytus hobleyi* tabulated in the present paper form a single interbreeding community.

Plate XXXVI represents, in figs. 14–17, some of the intermediate forms of *eurytus hobleyi* captured by me in Damba Island (1911)—a part of the series of which nearly the whole was described by Prof. Poulton in our Proceedings (1911, pp. xci–v; 1912, pp. xix–xxiii). Figs. 1–7 represent typical *Planema* models, and figs. 8–13, typical *Pseudacraea* mimics captured by Mr. C. A. Wiggins, D.P.M.O. of the Uganda Protectorate—fair examples of his great collection of these forms of which a part is published in "I. Congr. Internat. d'Ent.," 1910, vol. ii, p. 483. Fig. 10 represents the male-like female, *poggeoides*, of *Ps. eurytus hobleyi*, rare on Bugalla and Damba, even rarer near Entebbe, but common to the E. of the Nile, where *Pl. poggei* is found, but *Pl. macarista* absent (Proceedings, 1912, pp. lxx–lxxi). Plate XXXVI illustrates the intermediate forms of *Pseudacraea* that are relatively common on Damba as compared with the mainland—those intermediates that will be here shown by a much larger mass of evidence to be also characteristic of Bugalla. In correspondence with this resemblance between the *Pseudacraea* mimics of the two islands, Prof. Poulton has shown (*l. c.*) that the *Planema* models are relatively rare on Damba, and they are shown in the following tabular statement to be relatively rare on Bugalla. It must furthermore be borne in mind that the 127 Bugalla Planemas include 75 *epaea paragea*, and that special reasons for this large proportion are given later (p. 611). Mr. C. A. Wiggins' collection, between May 23 and Aug. 31, 1909, is analysed in our Proceedings, 1912, p. xciii, where it is shown that 244 Planemas and 82 forms of *eurytus hobleyi* were taken. What a contrast to the respective figures—127 and 356—for Bugalla!

In the tabular statement on p. 608 the numerical relations between the various *Planema* models and their mimics on Bugalla can be seen at a glance.

There were also taken during this period 17 *Mimacraea poultoni*, Neave, of which one specimen might be considered to be an outlying member of Combination Iʙ, as it had the orange of the hind-wings replaced by white. There was considerable variation amongst these Mimacraeas: one being of a paler yellow was a beautiful mimic of *Acraea viviana*, Staud. In the locality where the mimetic Lycaenids were taken, the model for the normal form of *poultoni* appeared to be *Acraea alicia*, E. M. Sharpe.

Combination.	Models.		Forms of Pseudacraea eurytus hobleyi, Neave.		Other Mimics.	
IA.	*Planema poggei nelsoni*, Grose-Sm. ♂ ♀	2 0	♀ forma mimetica *poggeoides*, Poulton (♀ *hobleyi* with ♂ coloration)	2	*Ps. kuenowi hypoxantha*, Jord. ♂ ♀ *Papilio dardanus*, Brown. ♀ f. m. *planemoides*, Trimen.	3 6 1
IB.	*Planema macarista*, E. M. Sharpe. ♂	10	♂ f. m. *hobleyi*	28	*Acraea alciope*, Hew. ♀ f. m. *aurivillii*, Staud. ♀ f. m. *alicia*, Grose-Sm., approaching typical western form Non-mimetic ♂ *Precis rauana*, Grose-Sm. ♀ Non-mimetic ♂	 11 (1) (5) 23 (24)
II.	*Planema macarista* ♀ *Planema alcinoe camerunica*, Auriv. ♀ Not mimicked ♂	7 2 (8)	♀ f. m. *tirikensis*, Neave.	40	*Acraea jodutta*, F. ♀ f. m. *jodutta*, F. Non-mimetic ♂	 3 (3)
			Forms transitional between ♂ *hobleyi*, ♀ *tirikensis* and ♂ ♀ *obscura*, Neave. ♂ ♀	23 22		
III.	*Planema epaea paragea*, Grose-Sm. ♂ ♀	41 34	f. m. *obscura*. ♂ ♀	7 19	*Papilio cynorta*, F. ♀ f. m. *peculiaris*, Neave. Non-mimetic ♂	 0 (1)
			Forms transitional between ♂ ♀ *obscura* and ♂ ♀ *terra*, Neave. ♂ ♀	26 11		
IV.	*Planema tellus eumelis*, Jord. (*platyxantha*, Jord.) ♂ ♀	24 9	f. m. *terra* ♂ ♀	56 48	*Acraea jodutta*, ♀ f. m. *dorotheae*, E. M. Sharpe	6
			Forms transitional between ♂ ♀ *terra* and ♂ *hobleyi* and ♀ *tirikensis*. ♂ ♀	36 38		
	Total Planemas . . .	127	Total *Ps. eurytus* . . .	356		

COMBINATION IA.

The model, *Planema poggei nelsoni* (Plate XXXVI, figs. 3, 4), was the scarcest of all the Planemas on Bugalla Island : I only succeeded in taking 2 males and no females during the 14 months I was there.

Its chief mimic, *Pseudacraea kuenowi hypoxantha*, was not so uncommon, 3 males and 6 females having been taken. This fine *Pseudacraea* seemed to vary very little indeed : a marked contrast to the protean *Ps. eurytus hobleyi.* I found it quite easy to distinguish the living *kuenowi* from the ♂ *hobleyi* : its flight is very much bolder, it seems even more alert, with brisker movements; and when seen on the flowers of bushes which it frequents, it appears to carry the wings in a slightly different manner. I have never been deceived by its likeness to the model as in the case of *hobleyi.*

Two females of *eurytus hobleyi* fall into this combination. They belong to the form *poggeoides* (Plate XXXVI, fig. 10), with a yellow band across the fore-wing. This is not quite of the same tint as the orange band of the male, and corresponds with the band of *poggei* rather than of the ♂ *macarista.*

A single specimen of the *planemoides* female of *Pap. dardanus* was obtained. It is worth noting that, although I had been collecting for two years before I came across this interesting butterfly, I was completely deceived by it. It was flying slowly in front of me in an open space in the forest belt, and my first thought was " What an enormous *Planema* ! ", so much did its general appearance and flight resemble its model. When captured, it lay perfectly still in the net, as does its model, instead of fluttering wildly like so many Papilios. This specimen is of particular interest, for from ova obtained from it I was able to rear the family exhibited at a meeting of the society (Proceedings, 1913, p. liii) and figured on Plate XXXIX of the present volume. It is worth mentioning that I only collected one other *dardanus* female on Bugalla—of the form *hippocoön*, F.

COMBINATION IB.

Of the model, the male *Pl. macarista* (Plate XXXVI, fig. 2), 10 were taken.

Acraeine mimics are represented by the female of *Acraea alciope*—synaposematic with the male *macarista* :

though many of these females have such a broad brownish border to the white band on the hind-wing that they are to some extent intermediate between the typical eastern Uganda ♀ form *aurivillii*, and the typical western female. Of the 17 *alciope* which were taken 5 were males, 11 were of the eastern form of female (*aurivillii*), and one transitional towards the typical western form, which closely resembles the male *Pl. alcinoe* mentioned below. The single transitional ♀ resembled this model so closely that I was quite deceived by it even after I had seen the specimens in the cabinet. The male *Acraea alciope* stands by itself, and does not mimic anything in either E. or W. Africa. The scarcity of this species on Bugalla Island is remarkable—and probably due to scarcity of its food-plant, which I never saw there. On another island, where I was previously (Damba), the food-plant was abundant, and *alciope* was extremely common.

The *Pseudacraea* mimic is the male of the mimetic form *hobleyi*, of *Ps. eurytus hobleyi* (Plate XXXV, fig. 12; XXXVI, fig. 9). This mimic is abundant on Bugalla, 28 having been captured. The resemblance is so close that I was often deceived until I had learnt to distinguish them.

Another Nymphaline member of this combination is *Precis rauana*, whose male is non-mimetic, but the female mimics well the male *macarista* : 24 males and 23 females were taken. This species is not often seen actually *within* the forest, but is to be found along the border-line between the forest and the open grass-land, or at the edge of the forest on the shore. In both these localities may be found beds of a thick-leaved aromatic Labiate herb, which may be the food-plant of the larva of this species. It is to be found also on the flowers of the " Gamboge " tree, *Haronga madagascariensis*, Chois. (*Hypericineae*), which particularly favours such localities, and attracts numbers of all the butterflies mentioned in this paper.

Precis rauana has the typical, very dashing and rapid flight of the genus to which it belongs, and is unlike that of its model. But the general impression gained from its appearance leaves no room for doubt that the female *is* a mimic of the male *Pl. macarista*. The male, having no white on the hind-wings, is not mimetic of this *Planema*, but on the other hand a fresh specimen often has such a rich crimson suffusion over the light-coloured band on the wings that I think it presents a decidedly Acraeine appearance when one gets a glint of crimson as it flashes past. Another interesting point is that this butterfly seems, at first, to rely for its protection upon the appearance of its upper surface. It is not always an easy species to catch; and if one strikes at it and fails, it will settle again and open and close its wings, displaying the colouring of the upper sides. If, however, one follows up and strikes again so that it is really alarmed, it will fly off and make use of the markedly procryptic, dead-leaf like appearance of the *underside*, sitting motionless with the wings brought together over its back. I endeavoured to obtain ova from captive females, putting them with branches of the aromatic herb before mentioned, but was unsuccessful. The early stages are, I believe, not known.

Combination II.

Seven examples of the principal model, the female of *Pl. macarista* (Plate XXXVI, fig. 1), were taken. A second model is provided by the female of *Pl. alcinoe camerunica*, of which 2 were captured, together with 8 males. The resemblance between these two female Planemas is extraordinarily close, so that it was a very long time before I was able to differentiate them. The male *alcinoe* is totally different and is of a type common in W. Africa, but comparatively rare in Uganda.

The black-and-white female of *Acraea jodutta*—the *jodutta* form of female—is beautifully synaposematic with the two *Planema* models. Of this mimic 3 were taken.

The models are closely mimicked by the abundant female of the form *tirikensis* (Plate XXXV, figs. 5, 6, 9; XXXVI, fig. 8) of *Pseudacraea eurytus hobleyi*, of which 40 were taken.

Combination III.

The model is the eastern form, *paragea* (Plate XXXVI, fig. 7), of the western species *Planema epaea*. Of this 41 males and 34 females were taken, so that it seems not uncommon. But these figures give a quite disproportionate idea of its relative abundance in the forests. I happened to hit upon a locality at the edge of the forest where the species seemed to collect in numbers owing to the attractiveness of certain flowers, and I naturally made a point of visiting this locality every evening, since I wanted as many specimens as I could obtain. Had I merely caught what I saw in the forests, it is doubtful if a dozen specimens would have been obtained. The Bugalla specimens are interesting as they are all very light-coloured, like the lightest forms obtained by Mr. Wiggins at Entebbe and presented by him to the Hope Department. They contrast very markedly with the 4 specimens which were all that I obtained in the forests of Damba Island, and were very dark indeed (Proc. Ent. Soc., 1912, pp. xxiii, lxxxvi).

The form of *eurytus hobleyi* mimetic of *paragea*, namely *obscura* (Plate XXXV, figs. 1, 10, 11, 13–16; XXXVI, fig. 13), was the least abundant of all the mimics into which this *Pseudacraea* subdivides, only 7 fully mimetic males and 19 such females being obtained.

The only other known mimic of *paragea*, namely the form *peculiaris* of *Papilio cynorta*, I did not obtain, much to my disappointment. The species does occur on the island, however, for I caught a single male, which is totally different in appearance from the female. It would be extremely interesting to ascertain whether the island female is also much paler than usual, following the model.

Combination IV.

The model is *Pl. tellus eumelis* (*platyxantha*), of which the male and female are alike (see Plate XXXVI, figs. 5, 6): 24 males and 9 females were captured. This species exhibits in a marked degree the nonchalance of a typical model. I spent a long time one evening trying to get a photograph of this butterfly on a clump of mauve Composite flowers, *Erlangea tomentosa*, S. Moore, which were extraordinarily attractive to all these butterflies; and although it frequently took alarm and flew away, it as frequently returned after a very short time. Indeed, I could almost have caught it in my hand.

There is one synaposematic *Acraea* in this Combination, namely *A. jodutta*, of which 3 males and 6 females of the *dorotheae* form were taken. The resemblance of this latter female form to *Pl. tellus* is extremely close, and until I had learnt the generic differences between *Acraea* and *Planema* I was always confusing the two. The specimens showed some variation: in one or two cases the black bar between the subapical and inner marginal tawny areas on the fore-wing is broken through, forming a variety comparable to those of *Ps. terra*, described on p. 613.

The form of *Ps. eurytus hobleyi*, mimetic of *Pl. tellus*, namely *terra* (Plate XXXV, figs. 2, 4; XXXVI, figs. 11, 12), was the most abundant of all the forms, 104 being taken altogether. Of these, 39 males and 26 females corresponded with the type, while 6 males and 20 females differed only by having the tawny subapical area on the fore-wing suffused with white scales to a greater or less extent. In 11 males and 1 female the black bar between the subapical and the inner marginal area was thinned or broken through, so that, in the most completely developed variety (No. 33 in list: Plate XXXIV, fig. 7) there is one large tawny area on the fore-wing of irregular shape, and bordered with black. An even more extreme form from Damba Island is represented on Plate XXXVI, fig. 16. To this variety Grünberg has given the name *impleta*.

TRANSITION IN BUGALLA ISLAND BETWEEN THE MIMETIC FORMS OF *Ps. eurytus hobleyi*.

I now come to the most interesting points, which this paper is intended to demonstrate. It will be seen in the tabular statement (pp. 618 et seqq.) that there are very many forms of *Pseudacraea eurytus hobleyi* not belonging to any of the types, but described as transitional.

(1) Between ♂ *hobleyi* with ♀ *tirikensis* and *obscura* there are 45 of these intermediates, (2) between *obscura* and *terra* 37, and (3) between *terra* and ♂ *hobleyi* with ♀ *tirikensis* 74.

Classes (1) and (3) are principally shown to be intermediate by the development in various degrees of the umber basal patch on the under surface of the hind-wing, a feature that is characteristic of the ♂ *hobleyi* and its ♀, *tirikensis*, but is absent from the typical *terra* and very faintly represented, and of a yellowish tint in the typical *obscura*. In (3), the umber triangle may be bordered, on the site of the white band of *hobleyi* and *tirikensis*, with whitish yellow, much paler than the rest of hind-wing under surface of *terra*. Furthermore the transition towards the ♀ pattern *tirikensis* in (1) and (3) is shown upon the upper surface by the whitish or whitish grey tint of the pale areas, especially the subapical bar, and, although to a less extent, the inner marginal patch of the fore-wing (Plate XXXIV, fig. 10; XXXV, figs. 3, 7, 8; XXXVI, figs. 14, 15). A slight tendency towards transition between *terra* and *hobleyi* is also sometimes seen in an orange suffusion at the costal end of the white bar crossing the hind-wing, a tendency which is feebly developed in the specimen figured on Plate XXXV, fig. 12, and is only strongly marked in a single specimen from Bugalla (Plate XXXIV, fig. 9, No. 57 on the list). This interesting example is a male with fore-wings like the typical *hobleyi*, but hind-wings above of the *terra* form. Below, the hind-wings show the umber triangle of *hobleyi* well developed. There is little doubt that this specimen is a blend of *terra* and *hobleyi*, but, as regards the former examples, with slight orange suffusion, it must be remembered that the ♂ *Pl. macarista* itself often exhibits the same coloration. Indeed, in W. Uganda, Mr. Neave collected 2 examples of *Pl. pseudeuryta*, Hew., with the pattern of *macarista*, but the hind-wing bar on the upper surface entirely orange; and one of these was accompanied by a ♂ *hobleyi* with the same colouring. It is therefore probable that the forms here referred to are a mimetic modification of the ♂ *hobleyi*.

Class (2), the intermediates between *obscura* and *terra*, form a far more perfect transitional series. Commencing with a *terra* which shows merely a slight dusky suffusion at the margins of the orange areas, and a little dark colour along the nervures, one can trace the gradual increase of the *obscura* dark colour until one reaches a point midway between the two forms (*e.g.* Plate XXXVI, fig. 17); beyond this the *terra* colour is more and more swamped until one gets to specimens of *obscura* showing only a sprinkling with orange scales on the inner margin of the fore-wing. S. A. Neave's type of *obscura*, in the Hope Department, is really one of these intermediate forms. What may be considered the *real obscura* has no orange colouring on the upper surface, and it is a much better mimic of its model, *Planema epaea paragea*.

The commonest form, of all those on the island, is *terra*, the least common, *obscura*. The latter appears to be the least stable: it is, in fact, quite difficult to find one which shows no transition towards *terra*, *hobleyi* or *tirikensis*, and even those not transitional exhibit considerable variation. On the other hand, the forms *hobleyi* and *tirikensis* appear to be the most stable: they are very true to type and show extraordinarily little variation. It has already been shown that they very strongly impress their most characteristic feature, the umber basal triangle, on the hind-wings of both *terra* and *obscura,* but it is almost impossible to find a specimen which one could describe as *hobleyi* or *tirikensis* influenced by *terra* or *obscura.* The specimen mentioned on p. 614 (Plate XXXIV, fig. 9), with fore-wings of *hobleyi* pattern and hind-wings of *terra* pattern, is the only exception to this which I have caught on Bugalla, out of the 356 Pseudacraeas. It has been pointed out on p. 614 that the ♂ *hobleyi* with an orange suffusion on the hind-wing are probably mimetic rather than transitional. I would suggest that, in Uganda at any rate, *hobleyi* and *tirikensis* are the most stable forms, and from them the others have been developed, namely *terra* and *obscura.*

The extraordinary number of transitional forms on Bugalla Island contrasts markedly with their scarcity on the mainland. In the very large collection presented by Mr. C. A. Wiggins to the Hope Department, which has been made in the neighbourhood of Entebbe on the mainland shore of the lake, only 25 miles or so to the N.E. of Bugalla Isle, there are relatively very few transitional specimens, and three out of the four mimetic patterns, viz. *hobleyi*, *tirikensis*, and *terra*, seem to keep very true to type. An account of the transitional forms observed in an examination of the 1909 material from Entebbe is published in "I. Congr. Internat. d'Ent.," 1910, vol. ii, p. 497. Among them was a form somewhat similar to that represented on Plate XXXIV, fig. 9, but much nearer to *terra* than this Bugalla specimen. *Obscura* appears to be an exception and to be variable on the mainland, but this form seems to be rare in the neighbourhood of Entebbe, and Mr. Wiggins' collection contains only a few specimens. Mr. Neave's much longer series from many localities in Uganda show great variety.

The explanation of this relative variability of the forms of *P. eurytus hobleyi* on Bugalla, and on Damba too, seems to be as follows :—

The various *Planema* models which abound on the mainland, are relatively extremely scarce on these islands. The figures for Bugalla and for a part of the Wiggins collection have been given on p. 607, and it was also pointed out on p. 611 that the number of *Planema epaea paragea* was not a correct measure of their true relative abundance. I believe this scarcity on the island is due to scarcity of food-plant. I know the food-plants of both *macarista* and *poggei*—creepers which I never saw at all on Bugalla Island.

Now on the island it is quite conceivable that an enemy of the Pseudacraeas might never see a *Planema* at all: at any rate the latter are so extremely scarce that they can have little protective value, and the Pseudacraeas would gain little by resembling models that are much less common than themselves. Consequently any form of *Pseudacraea* that is produced will have as much chance of surviving as the most perfect mimic, and the transitional forms appear almost as abundantly as the types. On the mainland, however, conditions are very different. Owing to the abundance of Planemas, their presence is of definite protective value to the Pseudacraeas, and varieties that are produced which do not conform rigidly to the types of the models are put at a disadvantage in the struggle for existence, and are destroyed by enemies in preference to the types. On the mainland the mimics are kept rigidly up to the mark, and transitional varieties between *hobleyi*, *tirikensis* and *terra* are by comparison rarely to be found. It may perhaps be argued that there is some condition productive of greater variability on the island, but not on the mainland. But though intermediate varieties are scarce on the mainland, yet they *do* occur, and it is difficult not to believe that they are rarely caught by collectors because they are so much more destroyed by enemies than are those which more closely resemble the models. If, as I believe, this explanation be the correct one, it supplies the strongest possible proof of the reality of mimicry and of the power of natural selection to preserve it—indeed it is a crucial test.

LOCALITIES REFERRED TO IN THE FOLLOWING TABLES.

Bugalla is a large island made up of broad northern and southern portions connected by an intermediate and comparatively narrow section. A narrow arm runs eastward from the northern part, Buninga, and meets at a right angle a less narrow northward extension from the southern part. At the angle of Kerinya, as this isthmus is called, and near its N.E. shore, my camp was situated on a forest-ringed grassy hill about 150 ft. above lake level. The place is known as Lutoboka or Fort Stanley. Kerinya itself is bordered right down to the shore with forest, behind which grassy downs rise to a height of about 350 ft. The forest belt is in some places very narrow, not more than 20 yards through. The localities indicated by letters in the tables are as follows :—

A. A narrow hippopotamus track through the forest belt which is here about 300 yards wide. There were no open spaces in its course. The butterflies were chiefly captured at the two ends.

B. Another path to the N.W. of A. The forest is here so narrow that the path is only about 20 yards long.

C. The sandy beach at the edge of the forest to the E. of my camp.

"On shore." A similar locality to the N. of camp.

D. At the landward edge where the forest is replaced by grass near the end of track A.

"At edge of forest." These words are used for the continuation of the forest edge N.W. from D to the end of track B.

E. The continuation of the forest edge S.E. from the landward end of track A. While all the other localities hitherto mentioned are only a few feet above lake level, the forest edge at E rises south-eastwards up to about 150 ft.

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		poggei nelsoni ♂	♀	*macarista* ♂	*macarista* ♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics $\mathrm{I_B}$	Non-mimetic ♂
1912. Jan. 15-31	At edge of forest .									2						
Jan. 23	In forest (B) . .															
Jan. 28	In forest (A) . .							1		1						
Feb. 14	In forest (A) . .															
Feb. 18	In forest (A) . .									1	1					
Feb. 15-29	Grassland near forest									1						
Feb. 24	In forest (A) . .								1							
Feb. 25	In forest (B) . .															
Feb. 25	In forest (A) . .															
Feb 26	In forest (A) . .															

NYMPHALINE MIMICS.						PAPILIONID MIMICS.			
Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi*		*Precis rauana*		*Papilio dardanus*		*Papilio cynorta*	
♂	♀	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" " IB ♀ "*tirikensis*" " II ♂ ♀ "*obscura*" " III ♂ ♀ "*terra*" " IV	♀ mimics I	♂ non-mimetic	♀ f. *planemoides* mimics IA	♂ non-mimetic	♀ f. *peculiaris* mimics III	♂ non-mimetic
						On Dec. 1, 1912, a *planemoides* female was taken, locality B in forest. From ova deposited by it 12 males, 3 *planemoides* females and 7 *hippocoon* females were reared.		No females were captured.	A single male was taken in forest, locality A, Apr. 22, 1912.
	1								
		1	♂ *terra*, f.-w. black, subapical bar thin.						
		2	♂ transitional, midway between *terra* and *obscura*.						
		3	♂ *terra*						
		4	♂ *terra*.						
		5	♂ *hobleyi*.						
		6	♀ *tirikensis*.						
1		7	♂ *terra*, f.-w. subapical area slightly suffused white.						
		8	♂ *obscura*, f.-w. inner margin slightly suffused *terra* orange.						
		9	♂ like 2.						
		10	♂ transitional, ground colour of *obscura;* trace of yellow suffusion f.-w. inner margin; h.-w. whitish at base especially at site of band of *hobleyi*, basal triangle strong below.						
		11	♂ *hobleyi*.						
		12	♀ *terra*.						
		13	♀ *terra*.						
		14	♀ *obscura* with trace of *terra* colour.						
		15	♂ *hobleyi*.						
		16	♀ *terra*.						
		17	♀ *terra*.						
		18	♀ *obscura*.						
		19	♂ *terra*, transitional to *obscura;* inner marginal f.-w. area very slightly suffused at edge with dark colour of *obscura*.						
		20	♂ *terra*, like 19, but subapical area small.						
		21	♂ *terra*, like 20.						
		22	♂ *terra*, transitional to *hobleyi*; subapical area white, inner marginal area rather dusky; h.-w. at base suffused with white, and basal triangle below well marked.						
		23	♀ *terra*, subapical area white, faintly suffused yellow; distinct basal umber suffusion h.-w. below.						
		24	♀ *obscura*, transitional to *tirikensis* ♀. F.-w. inner marginal and subapical areas and base of h.-w. whitish; distinct basal umber suffusion h.-w. below.						
		25	♂ *hobleyi*.						
		26	♂ *terra*.						
		27	♂ *terra*, very slight umber suffusion base h.-w. below.						
		28	♀ *tirikensis*.						

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A *poggei nelsoni.*		B *macarista*	*macarista*	*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
1912. Feb. 26	In forest (A)—*con.*															
Feb. 27	In forest (A) . .															
Feb. 28	In forest (A) . .															
Feb. 29	In forest (A) . .								1							
Mar. 10	In forest (A) . .															
Mar. 12	In forest (C) . .															
Mar. 14	In forest (C) . .								1							
Mar. 19	In forest (C) . .															
Mar. 27	In forest (C) . .															
Mar. 31	In forest (A) . .															

Nymphaline Mimics.					
Pseudacraea kuenowi hypoxantha. ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi.*		*Precis rauana*	
♂	♀	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		29	♀ transitional from *terra* to *tirikensis;* f.-w. subapical bar white, and inner marginal area very pale; h.-w. basal triangle very strongly developed.		
		30	♂ *hobleyi.*		
		31	♂ *hobleyi,* very dwarfed.		
		32	♂ *obscura,* h.-w. basal triangle fairly marked below.		
		33	♂ *terra,* variety somewhat resembling form "*fulvaria*"; it looked very different from typical *terra* on wing. F.-w. subapical and inner marginal areas enlarged, and black bar between them broken through, only represented at its outer part by tooth projecting from hind margin to about middle of wing.		
		34	♂ transitional *terra,* slightly suffused with *obscura;* dark colour on nervures and at margins of orange.		
		35	♂ *terra,* variety approaching 33, but subapical area slightly whiter than rest, and black tooth from hind margin just touches with its tip the costal black.		
		36	♂ *terra.*	1	
		37	♂ *terra.*		
		38	♂ *terra.*		
		39	♂ *terra,* h.-w. basal suffusion marked below.		
		40	♂ *hobleyi.*		
		41	♀ *tirikensis.*		
		42	♀ *terra,* f.-w. subapical bar white.		
		43	♀ *obscura,* transitional, large pale areas.		
		44	♂ *terra,* h.-w. basal triangle well marked below.		
		45	♂ transitional, like 2.		
		46	♀ *terra,* ragged and deformed.		
		47	♂ *hobleyi.*		
		48	♀ *tirikensis.*		
		49	♀ *terra,* slight umber basal suffusion h.-w. below.		
		50	♀ *terra,* h.-w. as above: f.-w. subapical area suffused white.		
		51	♀ *obscura,* slight basal suffusion h.-w. below.		
		52	♂ *obscura,* fairly marked basal suffusion h.-w. below.		
		53	♂ transitional between *obscura* and *terra.* F.-w. subapical area very small and richly coloured, inner marginal orange represented by two patches orange suffusion: slight basal suffusion h.-w. below.		
		54	♀ *poggeoides.*		
		55	♀ *terra,* transitional to *tirikensis*; f.-w. subapical area slightly suffused white; distinct basal triangle h.-w. below.		
		56	♀ *terra,* transitional to *tirikensis;* f.-w. subapical area white, inner marginal area suffused white. H.-w. below bar has marked basal triangle.		
		57	♂ remarkable specimen. F.-w. of ♂ *hobleyi* pattern, h.-w. of *terra,* with basal triangle so well marked that it is also visible above.		1
		58	♀ *tirikensis.*		
		59	♀ *tirikensis.*		
		60	♀ *obscura,* like 51.		
		61	♀ transitional, midway between *obscura* and *terra.*		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		poggei nelsoni ♂	*poggei nelsoni* ♀	*macarista* ♂	*macarista* ♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
1912. April 1	In forest (C) . .															
April 2	In forest (A) . .										1					
April 4	In forest (C) . .															
April 7	In forest (A) . .															
April 8	Edge of forest in evening . . .									1						
April 13	In forest (C) . .															
April 14	In forest (A) . .															
April 17	In forest (C) . .															
April 22	In forest (A) . .															
April 24	In forest (C) . .												1 (subapical orange area slightly suffused white)			
April 26	In forest (C) . .															
April 28	In forest (A) . .															
May 5	In forest (A) . .															

NYMPHALINE MIMICS.				
Pseudacraea kuenowi hypoxantha. ♂ ♀ mimics IA	Forms of *Pseudacraea eurytus hobleyi*		*Precis rauana*	
	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
	62	♂ *obscura*, slight umber suffusion base h.-w. below.		
	63	♂ *terra*.		
	64	♂ *terra*.		
	65	♂ *terra*.		
	66	♀ *tirikensis*.		
	67	♀ *obscura*.		
	68	♀ *obscura*, h.-w. rather pale above; distinct umber basal suffusion below.		
	69	♀ *terra*, like 55.		
	70	♂ *obscura*, like 62.		
	71	♀ *terra*, like 50.		
	72	♂ *hobleyi*.		
	73	♀ *tirikensis*.		
	74	♀ *tirikensis*.		
	75	♀ *terra*, white subapical area, f.-w.; very slight basal umber suffusion h.-w. below.		
	76	♀ *terra*, like 56.		
	77	♀ *terra*, black bar on f.-w. thinned.		
	78	♀ *terra*, transitional to *obscura*; slight dusky suffusion on margin of f.-w. inner marginal area.		
	79	♀ *terra*, like 49.		
	80	♂ *terra*, variety. Black subapical bar broken through at its middle, the black costal area suffused with orange at its posterior border, with one well-defined round mark at end of cell.		
	81	♀ *terra*, like 77.		
	82	♀ *obscura*: transitional to *tirikensis*; h.-w. marked basal umber below.		
	83	♀ *obscura*.		
	84	♂ *terra*.		
	85	♂ *hobleyi*.		
	86	♀ transitional, like 61.		
	87	♀ *terra*.		
	88	♀ *obscura*, like 51.		
	89	♂ *terra*, like 27.		
	90	♂ *terra*.		
	91	♂ *terra*, f.-w. subapical area very slightly suffused white; h.-w. basal area very slightly suffused umber.		
	92	♀ *terra*.		
	93	♀ *terra*, like 50.		
	94	♂ *terra*, like 1.		
	95	♂ *hobleyi*.		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A *poggei nelsoni*		B *macarista*	*macarista*	*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics I_B	Non-mimetic ♂
1912. May 5	In forest (A)—*con.*															
May 8	In forest (C) . . .				1											
May 19	In forest (A) . . .															
May 20	In forest (C) . . .															
June 1	In forest (C) . . .															
June 2	In forest (A) . . .															
June 16	In forest (A) . . .															
June 26	In forest (A) . . .				1											
June 30	In forest (A) . . .															
July 5	Edge of forest near (A)															
July 7	Edge of forest . . .															
July 11	In forest (C) . . .							1								
July 15	At edge of forest (D) .															

NYMPHALINE MIMICS.						
Pseudacraea kuenowi hypoxantha. ♂ ♀ mimics. IA		Forms of *Pseudacraea eurytus hobleyi.*			*Precis rauana*	
		Serial number		♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		96	♂	transitional, from *obscura* to *hobleyi*. F.-w. white subapical area; faintly indicated inner marginal area of *hobleyi* ♀; h.-w. pale at base, well marked basal triangle below.		
		97	♂	*terra*.		
		98	♂	*terra*, like 39.		
		99	♂	transitional, between *terra* and *obscura*. F.-w. subapical area small and whitish: inner marginal area contracted, of *terra* colour; h.-w. rather pale yellow at base.		
		100	♀	*terra*.		
		101	♀	*terra*, like 50.		
		102	♀	*terra*, f.-w. areas large and whitish, with black bar between much thinned.		
		103	♂	*terra*, like 19.		
		104	♀	*terra*, subapical f.-w. area large and white.		
		105	♀	transitional between *obscura* and *tirikensis*. F.-w. subapical area cream coloured, inner marginal area duskily suffused. H.-w. pale cream at base, tending to white in position of *tirikensis* band; basal triangle below distinct.		
		106	♂	*hobleyi*, white h.-w. bar suffused yellow at periphery.		
		107	♀	*tirikensis*.		
		108	♂	*terra*.		
		109	♂	transitional, like 2.		
		110	♂	transitional from *obscura* to *hobleyi*, *obscura* ground colour; f.-w. subapical area small, cream coloured; inner marginal area suffused with yellow; h.-w. pale creamy white at base; basal triangle below distinct.		
		111	♀	*terra*, f.-w. subapical area very large.		
		112	♀	*obscura*, transitional to *tirikensis*; h.-w. rather pale at base, with well marked basal triangle below.		
		113	♀	*terra*, like 50.		
		114	♀	*terra*, like 50.		
		115	♀	*terra*, f-w. subapical area suffused white anterior and posterior ends; inner marginal area very slightly paler than h.-w.; basal triangle distinct.		
		116	♂	*terra*, like 27.		
		117	♀	*terra*, f.-w. subapical area white, and anterior border of inner marginal area suffused white.		
		118	♀	*terra*, like 117.		
		119	♀	*terra*, f.-w. subapical area suffused white anterior and posterior ends.		
		120	♀	*obscura*, like 51 (parent of series B).		
		121	♂	*terra*.		
		122	♂	*terra*, transitional to *hobleyi*; f.-w. subapical area white, h.-w. at basal triangle distinct below.		
		123	♀	*obscura*, like 51 (parent of series D).		
		124	♀	*obscura*, f.-w. subapical area white, inner marginal area and most of h.-w. creamy.		

Date.	Locality.	Acraeine (*Planema*) Models.										Acraeine Mimics.				
		I				II		III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		poggei nelsoni		*macarista*	*macarista*											
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
1912. July 16	At edge of forest (D)															
July 17	At edge of forest (D)															
July 19	At edge of forest (D)															
July 21	At edge of forest (D)															
July 21	In forest (A) . .															
July 22	In forest (C). . .															1
July 23	At edge of forest (D)															
July 24	At edge of forest (D)						1									
July 26	At edge of forest (D)															
July 28	At edge of forest (D)															
July 29	At edge of forest (D)										1					
July 30	At edge of forest (E)							2	2							
July 31	At edge of forest (E)							3	3							

NYMPHALINE MIMICS.					
Pseud-acraea kuenowi hypo-xantha ♂ ♀ mimics IA		Serial number	Forms of *Pseudacraea eurytus hobleyi*	*Precis rauana*	
♂	♀		♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		125	♀ *terra.*		1
		126	♀ *terra*, like 119.		
		127	♀ *obscura*, transitional to *tirikensis*, like 24.		1
		128	♂ *terra*, f.-w. black subapical bar of very irregular outline and almost cut through at anterior and posterior ends. This specimen looked distinctly different from type on wing: there is also a narrow streak of light fulvous at the black apex of the cell.		
		129	♂ *terra*, like 7.		
		130	♀ *tirikensis.*		
		131	♂ *terra*, f.-w. subapical area has faint trace white suffusion at posterior end.		
		132	♂ *terra*, like 27.		
		133	♂ *obscura.*		
		134	♂ transitional, midway between *obscura* and *terra;* h.-w. shows marked basal triangle below.		
		135	♀ *terra*, like 119.		
		136	♀ *terra*, like 119.		
		137	♀ *terra*, like 115.		
		138	♀ *terra*, like 115.		
		139	♂ *terra* } recorded as captured, but since mislaid.		
		140	♀ *terra* }		
		141	♂ *terra.*		
		142	♂ *terra.*		
		143	♂ *obscura*, transitional to *hobleyi;* f.-w. inner margin shows slight suffusion yellow; h.-w. basal triangle below distinct.		
		144	♀ *terra.*		
		145	♀ *terra.*		
		146	♂ *hobleyi*, like 105.		
		147	♀ *tirikensis.*		
		148	♂ *terra.*		2
		149	♂ *hobleyi.*		
		150	♂ *terra*, f.-w. inner marginal area small; h.-w. basal triangle well marked below.		
		151	♂ *terra*, like 150.		
		152	♀ *tirikensis* (parent of series E).		
		153	♂ *obscura.*		
		154	♀ *obscura.*		
	1	155	♂ *terra*, like 91.		1
		156	♀ *terra*, like 50.		
		157	♀ transitional between *obscura* and *tirikensis.* All pale markings of *obscura* white, and basal triangle on h.-w. very marked.	1	1
		158	♀ *terra*, f.-w. subapical area suffused white at each end; h.-w. shows distinct basal triangle below.		
		159	♂ *obscura*, like 32.		
		160	♀ *terra*, transitional to *tirikensis.* Ground-colour very dark; f.-w. subapical area white; h.-w. basal triangle marked.		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A *poggei nelsoni*		B *macarista*	*macarista*	*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		♂	♀	♂	♂	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
1912. Aug. 1	At edge of forest (E)	1		1 (the outer border of white h.-w. band strongly suffused with orange.)				2	1							
Aug. 2	At edge of forest (E)					1		2	3	1						
Aug. 2	At edge of forest (D)															
Aug. 3	At edge of forest (E)							4							1 (broad brown border to white h.-w. band.)	
Aug. 4	At edge of forest (D)			1										1		
Aug. 4	At edge of forest (E)							2	1							
Aug. 5	At edge of forest (E)												1 (*transitional* to *jodutta*. F.-w. subapical area white, but inner marginal area and h.-w. area pale yellowish white; the outer margin of this on h.-w. bordered with red brown suffusion over the normal dark brown.)			
Aug. 6	At edge of forest (E)							3	1							
Aug. 6	At edge of forest (D)															

NYMPHALINE MIMICS.					
Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi.*		*Precis rauana*	
♂	♀	Serial numbers	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		161	♂ *terra*, like 39.		
		162	♀ *obscura.*		
		163	♂ *terra.*		
		164	♂ *terra*, f.-w. subapical and inner marginal area whitish; h.-w. basal triangle distinct below.		
	1	165	♀ *terra* (parent of series F).		
		166	♂ *obscura*, like 32.		
		167	♂ *terra*, faint dusky suffusion f.-w. inner margin; subapical area white.		
		168	♀ *tirikensis.*		2
		169	♂ *obscura*, all pale areas rather whitish.		
		170	♀ *terra*, like 49.		
				1	1
		171	♂ *obscura*, transitional to *hobleyi*: trace yellow suffusion f.-w. inner margin; h.-w. whitish at base, basal triangle marked below.		
		172	♂ *hobleyi.*		
		173	♂ transitional, like 2.		
		174	♀ *tirikensis* (parent of series G).		
		175	♀ *obscura*, like 24.		
		176	♀ *terra*, f.-w. subapical area white, inner marginal area suffused white; trace basal triangle h.-w. below.		
				1	2

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		poggei nelsoni		*macarista*	*macarista*	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
		♂	♀	♂	♀											
1912. Aug. 6	At edge of forest (E)				1			3								
Aug. 7	On shore . . .															
Aug. 8	At edge of forest (D)														2 (one female is transitional between the eastern and western forms.)	2
Aug. 8	At edge of forest (E)							1							1 (broad orange border to h.-w. white bar.)	
Aug. 9	At edge of forest (D)															
Aug. 9	At edge of forest (E)							2	1							
Aug. 10	Near camp, at edge of forest . . .														1	
Aug. 10	At edge of forest (D)												1 (white f.-w. subapical area.)		1 (intermediate between E. and W. forms.)	
Aug. 10	At edge of forest (E)							2	2							
Aug. 10	In forest (B) . .						1									
Aug. 11	In forest (A) . .															
Aug. 11	At edge of forest (E)						1									
Aug. 11	At edge of forest (D)									1						

NYMPHALINE MIMICS.

Pseud-acraea kuenowi hypo-xantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi*		*Precis rauana*	
♂	♀	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		177 178	♀ *tirikensis*, like 54. ♀ *terra*, like 176.		
				1	
					2
		179	♀ *tirikensis.*		
				1	
		180 181 182	♂ transitional, like 2. ♂ transitional, midway between *obscura* and *terra*, with trace of basal umber suffusion on h.-w. below. ♀ *obscura*, like 124.		
1		183 184 185	♂ *obscura.* ♂ *obscura.* ♀ *obscura.*	2	1
		186 187 188	♂ *terra.* ♀ *tirikensis.* ♀ *terra*, like 78.		
		189	♀ *terra*, like 119.		
		190 191 192 193 194	♂ *terra.* ♂ *terra*, like 19. ♀ *tirikensis.* ♀ *tirikensis.* Both h.-ws. symmetrically shorn off near base. ♀ *terra*, f.-w. inner marginal area slightly suffused white.		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*		*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics I$_B$	Non-mimetic ♂
		poggei nelsoni		*macarista*	*macarista*											
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀					
1912. Aug. 12	At edge of forest (D)						1				1					
Aug. 12	At edge of forest (E)	1							1							
Aug. 13	At edge of forest (E)							2	3	1						1
Aug. 14	At edge of forest (E)							1							1 (broad brown border to h.-w. white band)	
Aug. 15	At edge of forest (E)			1				1	1	1						
Aug. 16	At edge of forest (E)			1 (h.-w. white band yellow at anterior end and outer border)					1							
Aug. 16	At edge of forest (D)															
Aug. 17	In forest (B) . .								1							
Aug. 17	At edge of forest (E)			1 (like the last)	1			1		1						
Aug. 18	In forest (A) . .															
Aug. 18	At edge of forest (E)							1	1						1	
Aug. 19	At edge of forest (E)									2	1					
Aug. 19	At edge of forest (D)						1									
Aug. 20	At edge of forest (D)			2											1	

NYMPHALINE MIMICS.

Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi*		*Precis rauana*	
		Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		195	♂ *obscura.*	1	1
		196 197 198	♂ *terra,* like 1. ♀ *terra,* f.-w. subapical area whitish. ♀ *obscura,* transitional to *terra*; f.-w. inner margin has very slight yellow suffusion.		
		199 200	♂ *hobleyi.* ♂ *terra,* like 7.		
		201 202	♂ transitional, like 2. ♀ *tirikensis.*		
				1	
		203 204 205	♂ *terra,* like 27. ♀ *terra,* f.-w. subapical and inner marginal areas slightly suffused white. ♀ transitional from *obscura* to *tirikensis.* F.-w. subapical area large and cream coloured; inner marginal area slightly suffused yellow; h.-w; cream coloured, with paler band at base; basal triangle marked below.		
		206 207 208	♂ *terra,* like 122. ♂ *terra,* like 91. ♀ *terra,* like 50.		
		209 210 211 212 213	♂ *obscura.* ♂ *terra.* ♀ *terra.* ♀ *terra,* f.-w. subapical area white, with yellow along nervures; h.-w. below shows distinct basal umber suffusion. ♀ *terra,* like 212.		
		214	♀ *terra,* like 176.		
		215	♀ *obscura,* f.-w. subapical area large and whitish. Margin of one h.-w. very ragged and torn as if by lizard.	1	

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A *poggei nelsoni*		B *macarista*	*macarista*	*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
1912. Aug. 20	At edge of forest (E)								1	1	1					
Aug. 21	At edge of forest (E)				1				2							
Aug. 22	At edge of forest (E)							1								
Aug. 24	At edge of forest (E)						1	1								
Aug. 26	At edge of forest (D)												1 (black f.-w. bar broken at hind margin, so that subapical and inner marginal areas are continuous; they are suffused with white near costa) 1 (f.-w. orange areas suffused with white)			1
Aug. 26 " 27	At edge of forest (E)							1	2	2 1 (f.-w. subapical area white, and inner marginal area suffused white)	1	1				
Aug. 28	At edge of forest (D)										1					

NYMPHALINE MIMICS.					
Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi*		*Precis rauana*	
♂	♀	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" " IB ♀ "*tirikensis*" " II ♂ ♀ "*obscura*" " III ♂ ♀ "*terra*" " IV	♀ mimics I	♂ non-mimetic
		216	♂ *terra*, like 39.		
		217	♂ *terra*, like 122.		
		218	♀ *terra*, like 78.		
		219	♂ *terra*, f.-w. subapical area suffused white at both ends.		
		220	♂ *terra*, variety; f.-w. subapical area large and connected with inner marginal area by isthmus, the black bar being broken at costal end and the cell suffused with yellow.		
		221	♂ *hobleyi*. F.-w. band slightly suffused white at posterior end.		
		222	♀ *tirikensis*.		
		223	♀ *tirikensis*.		
		224	♀ *terra*, like 119.		
		225	♂ *terra*.		
		226	♂ *hobleyi*.		
		227	♀ *tirikensis*.		
		228	♀ *terra*.		
		229	♀ *obscura*.		
		230	♀ *terra*, like 176.		
				2	
		231	♂ *hobleyi*.		
		232	♂ *terra*.		
		233	♂ *terra*.		
		234	♂ *terra*.		
		235	♂ *terra*, like 27.		
		236	♂ *terra*, like 27.		
		237	♂ *obscura*, transitional to *hobleyi*. F.-w. subapical area white; h.-w. basal umber suffusion marked below.		
		238	♀ *tirikensis*.		
		239	♀ *terra*, like 78.		
		240	♀ *terra*, like 42.		
		241	♀ *terra*, transitional to *tirikensis*. F.-w. subapical area small and white: inner marginal area small, suffused white; h.-w. below shows distinct basal triangle.		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I				II		III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		poggei nelsoni		*macarista*	*macarista*											
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
1912. Aug. 28	At edge of forest (E)															
Aug. 29	In forest (B) . .															
Aug. 29	At edge of forest (D)															
Aug. 29	At edge of forest (E)								1							
Aug. 31	At edge of forest (E)								1							
Sept. 2	At edge of forest (E)					1		1								
Sept. 3	At edge of forest (E)						1	1								
Sept. 4	At edge of forest (D)															
Sept. 5	At edge of forest (E)															
Sept. 7	At edge of forest (D)															
Sept. 9	In camp, near forest												1			
Sept. 9	At edge of forest (E)									1 1 (f.-w. subapical and inner marginal areas pale)						
Sept. 10	At edge of forest (D)														1 (broad brown border to white h.-w. band)	
Sept. 11	At edge of forest (D)															

NYMPHALINE MIMICS.					
Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Serial number	Forms of *Pseudacraea eurytus hobleyi* ♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	*Precis rauana* ♀ mimics I	*Precis rauana* ♂ non-mimetic
		242	♂ *terra.*		
		243	♀ *terra*, f.-w. black bar thinned.		
		244	♀ *terra*, like 243.		
		245	♀ *obscura.*		
		246	♀ *obscura*, like 51.		
		247	♂ *terra*, like 27.		
					1
		248	♂ transitional, like 34.		
		249	♀ *terra.*		
		250	♂ *terra.*		
		251	♂ *terra*, like 7.		
		252	♀ *obscura*, h.-w. shows well-marked umber basal suffusion below.		
		253	♂ transitional, like 2.		
		254	♀ *terra*, like 49.		
		255	♂ transitional, like 2.		
		256	♂ *terra*, like 27.		
		257	♂ *obscura*, like 143.		
		258	♂ *obscura*, like 143.		
		259	♂ *obscura*, like 143.		
		260	♀ *terra.*		
		261	♀ *obscura*, like 24.		
		262	♂ *terra.*	1	1
		263	♂ *obscura*, transitional to *hobleyi.* F.-w. subapical and inner marginal areas pale cream; also h.-w. Basal umber suffusion on h.-w. below marked.		
		264	♂ *obscura*, like 143.		
		265	♀ *tirikensis.*		
		266	♀ *obscura*, like 51.		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*		*jodutta* ♀ mimics II	*doro heae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
		poggei nelsoni		*macarista*	*macarista*											
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀					
1912. Sept. 11	At edge of forest (D) —*continued*															
Sept. 12	At edge of forest (D)													1	1 (this specimen nearly approaches ♀ f. *alicia*, but is to some extent transitional)	
Sept. 14	At edge of forest (D)											1				
Sept. 15	At edge of forest (E)															
Sept. 16	At edge of forest (D)									1						
Sept. 16	At edge of forest (E)															
Sept. 17	At edge of forest (D)															
Sept. 19	At edge of forest (E)															
Sept. 19	At edge of forest (D)															
Sept. 21	At edge of forest (D)															
Sept. 26	At edge of forest (E)				1											
Oct. 2	At edge of forest (E)															
Oct. 4	In forest (C) . .															
Oct. 9	At edge of forest .															
Oct. 10	At edge of forest (E)				1											
Oct. 13	In forest (A) . .															
Oct. 17	At edge of forest (E)									1						

NYMPHALINE MIMICS.

Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi.*		*Precis rauana*	
♂	♀	Serial number	♀ " *poggeoides* " mimicking IA ♂ " *hobleyi* " ,, IB ♀ " *tirikensis* " ,, II ♂ ♀ " *obscura* " ,, III ♂ ♀ " *terra* " ,, IV	♀ mimics I	♂ non-mimetic
		267 268	♀ *obscura*, like 51. ♀ *obscura*, like 43.		
		269 270 271	♀ *tirikensis.* ♀ *obscura*, like 51 (parent of series H). ♀ *terra*, like 56. Both h.-ws. have large part of periphery missing, the damage on right side also extending to hind margin of f.-w. ? attack by bird.	2	1
		272 273 274 275	♂ *obscura*, like 8. ♀ *terra*, like 104. ♀ *terra*, like 104. ♀ *tirikensis*, f.-w. white subapical area suffused yellow on outer margin.	1	2
	1	276 277	♂ *obscura*, like 143. ♂ *terra.* F.-w. shows slight suffusion with yellow on costa just internal to subapical area. This was enough to give the specimen an appearance different from the typical form on the wing.		
		278 279 280 281	♂ *obscura*, like 263. ♀ *tirikensis.* ♀ *terra.* ♀ *terra.*		
		282 283	♂ *obscura*, like 32. ♀ transitional, like 29 : ground-colour very dark.		
		284	♂ *obscura*, like 143.		1
		285 286	♀ *tirikensis.* ♀ *obscura*, like 51.		
		287	♂ *terra*, like 27.		
		288	♀ *terra.* F.-w. subapical area white : inner marginal area duskily suffused.	3	
		289	♂ *terra*, like 19.		
		290 291	♂ transitional, like 2. ♀ *terra.*		
		292	♂ *hobleyi.*		
					1
		293 294	♂ *terra.* ♀ *terra.*		
		295 296	♂ *terra*, like 122. ♀ *tirikensis* (parent of series J).		
		297	♂ *hobleyi.*		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I				II		III		IV		*Acraea jodutta*			*Acraea alciope*	
		A *poggei nelsoni*		B *macarista*	*macarista*	*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics I B	Non-mimetic ♂
1912. Oct. 17	At edge of forest (E) —*continued*															
Oct. 19	In forest (C) . .															
Oct. 19	At edge of forest (E)															
Oct. 22	At edge of forest (E)															
Oct. 23	In forest (C) . .															
Oct. 28	At edge of forest (E)							1								
Nov. 1	At edge of forest (E)															
Nov. 1	At edge of forest (D)										1				1 (beautifully intermediate between E. and W. forms)	
Nov. 2	At edge of forest (E)															
Nov. 3	In forest (A) . .															
Nov. 5	At edge of forest (E)									1						
Nov. 7	At edge of forest (E)															
Nov. 13	At edge of forest (E)															

NYMPHALINE MIMICS.

Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Serial number	Forms of *Pseudacraea eurytus hobleyi*	*Precis rauana*	
♂	♀		♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		298	♂ *terra.*		
		299	♂ *terra.*		
		300	♀ *terra.*		
		301	♀ *obscura*, like 43.		
		302	♂ *hobleyi.*		
		303	♂ *obscura*, like 62.		
		304	♂ *terra*, like 39.		
		305	♂ *terra*, like 122.		
		306	♂ *terra*, like 122.		
		307	♂ *hobleyi.*		
		308	♀ *terra*, like 42 (parent of series K).		
		309	♂ *terra.*		
		310	♂ *terra*		
		311	♀ *tirikensis.*		
		312	♀ *tirikensis.*		
		313	♀ *terra*, pale ground-colour; f.-w. subapical area large and cream coloured; inner marginal a·ea duskily suffused.		
		314	♀ *tirikensis.*		
		315	♀ *tirikensis.*		
		316	♂ *terra*, like 27.		
		317	♂ transitional like 2.		
		318	♀ *obscura*, like 51.		
		319	♂ *hobleyi.*		
		320	♀ *terra.*		
		321	♂ *terra.*		
		322	♂ *hobleyi*, white h.-w. band small, suffused yellow anteriorly.		
		323	♂ *obscura*, transitional to *hobleyi*: h.-w. rather whitish at base, and basal triangle well marked below.		
		324	♀ remarkably interesting specimen coming very near to the typical W. *eurytus*. Ground-colour of *tirikensis* ♀. F.-w. subapical area, in size and position that of *terra*, is white: inner marginal area contracted, also white. H.-w. has white base, and close to origin is slightly suffused with yellow. Black border to white is broader than in typical *tirikensis*. Basal umber suffusion below h.-w. poorly developed.		
		325	♀ *obscura*, like 43.		
		326	♂ *terra*, like 91.		
		327	♀ *terra*, like 50.		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A		B		*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		poggei nelsoni		*macarista*	*macarista*	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics IB	Non-mimetic ♂
		♂	♀	♂	♀											
1912. Nov. 13	At edge of forest (E) —*continued*															
Nov. 18	In forest (C) . .															
Nov. 23	At edge of forest (E)															
Nov. 24	On shore . . .															
Dec. 1	At edge of forest (E)			1												
Dec. 6	At edge of forest (E)															
Dec. 6	At edge of forest (D)															
Dec. 8	In forest (A) . .															
Dec. 9	At edge of forest (E)															
Dec. 13	At edge of forest (E)															
Dec. 16	At edge of forest (D)			1												
Dec. 19	At edge of forest (E)															
Dec. 20	At edge of forest (E)															
Dec. 21	At edge of forest (E)															
Dec. 27	At edge of forest (E)															
Dec. 30	At edge of forest (E)															
1913. Jan. 5	In forest (A) . .															
Jan. 8	In forest (B) . .															
Jan. 12	In forest (A) . .											1				
Jan. 25	At edge of forest (E)													1		
Jan. 26	In forest (A)															
Feb. 13	At edge of forest (E)							1	1							

NYMPHALINE MIMICS.					
Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA			Forms of *Pseudacraea eurytus hobleyi*	*Precis rauana*	
♂	♀	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
		328 329	♀ *tirikensis.* ♀ *terra*, f.-w. subapical area very large; black bar thinned.		
		330	♀ *obscura.*		
		331	♀ *obscura.*		
				1	
		332	♀ *terra*, like 204.		
		333	♀ *tirikensis.*	1	1
		334	♂ *terra.*		
	1				
		335	♂ *terra.*		
					1
		336 337	♂ *hobleyi.* ♀ *terra*, like 42.		
		338 339 340 341 342	♂ *hobleyi.* ♀ *tirikensis.* ♂ *terra*, like 39. ♀ *terra*, f.-w. subapical area large and suffused white; black bar very much thinned; distinct basal umber h.-w. below. ♀ *terra*, like 158.		
		343	♀ *terra*, transitional to *obscura* : f.-w. subapical area small and whitish; inner marginal area duskily suffused.		
		344 345	♂ *terra*, f.-w. subapical and inner marginal areas contracted; h.-w. below shows distinct basal umber suffusion. ♀ *terra*, like 111.		
	1	346	♂ *hobleyi.*		
		347 348	♂ *terra.* ♀ *tirikensis.*		
				1	
		349 350 351 352	♂ *terra*, like 39. ♀ *obscura.* ♀ *terra.* ♀ *terra*, like 50.		
		353 354 355	♂ *terra*, like 344. ♂ *hobleyi.* ♀ *obscura.*		

DATE.	LOCALITY.	ACRAEINE (*Planema*) MODELS.										ACRAEINE MIMICS.				
		I			II			III		IV		*Acraea jodutta*			*Acraea alciope*	
		A *poggei nelsoni*		B *macarista*	*macarista*	*alcinoe camerunica*		*epaea paragea*		*tellus eumelis*						
		♂	♀	♂	♀	♀	♂ not mimicked	♂	♀	♂	♀	*jodutta* ♀ mimics II	*dorotheae* ♀ mimics IV	Non-mimetic ♂	*aurivillii* ♀ mimics I_B	Non-mimetic ♂
1913. Feb. 15	At edge of forest (E)			1 (posterior end of f.-w. band slightly whitish; anterior end h.-w. band yellow)					1	2						
Feb. 17	At edge of forest (E)						1									
Feb. 25	At edge of forest (E)															
Mar. 6	In forest (B)															

EXPLANATION OF PLATE XXXIV.

The figures are about $\frac{5}{8}$ of the natural size.

Transitional forms of *Pseudacraea eurytus hobleyi*, Neave, from Bugalla Island, one female (fig. 11) resembling a typical western female of *eurytus*, L., from the Lagos district, represented in fig. 12 with its model, *Planema epaea*, from the same locality, in fig. 13.

Figs. 1–8 a series of the form *terra*, showing a very gradual transition from an almost typical example (1) to three specimens (6–8) in which the subapical bar is distinctly continuous with the great triangular patch of the fore-wing. Fig. 8 represents a not quite typical form of the var. *impleta*, Grünb.

FIG. 1. At edge of forest (Locality D), Sept. 7, 1912. Form *terra*, ♀. No. 260 in list. The black bar between subapical and inner marginal yellow areas is thinned.

2. In forest (A), April 7, 1912. Form *terra*, ♀. No. 77 in list. The thinning of the black bar is marked.

3. At edge of forest (E), Sept. 15, 1912. Form *terra*, ♂. No. 277 in list. The slight yellow suffusion of black costal border gave the specimen a different appearance on the wing. This specimen has been noted in Proc. Ent. Soc., Dec. 4, 1912, p. cxxxviii.

4. At edge of forest (E), Nov. 13, 1912. Form *terra*, ♀. No. 329 in list. Black bar nearly broken through.

5. At edge of forest (D), July 17, 1912. Form *terra*, ♂. No. 128 in list. Like 4. There is a streak of bright fulvous colour on the black apex of the cell. This specimen looked different from the type on the wing.

6. At edge of forest (E), Aug. 21, 1912. Form *terra*, ♂, variety. No. 220 on list. The black bar is broken through at the inner end.

7. In forest (A), Feb. 27, 1912. Form *terra*, ♂, variety. No. 33 on list. Like 6 but process has been carried farther.

8. In forest (C), April 13, 1912. Form *terra*, ♂, variety. No. 80 on list. Black bar broken through in its middle, and a well-marked fulvous spot in the black area of the cell.

Explanation of Plate XXXIV.

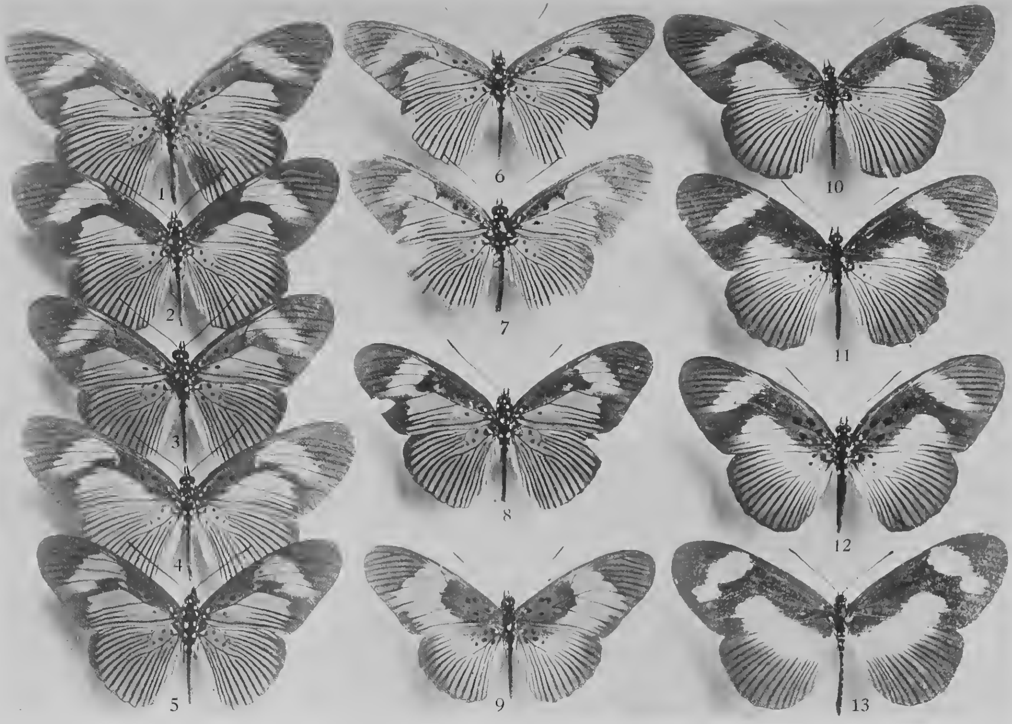
Fig. 9. In forest (C), March 19, 1912. ♂ transitional specimen. No. 57 in list. Fore-wings of pattern of ♂ *hobleyi* form; hind-wings of pattern of *terra* form, with the basal triangle of *hobleyi* superposed.

10. In forest (A), Feb. 26, 1912. ♀ transitional specimen. No. 29 in list. Pattern of *terra*, but fore-wing subapical area white like ♀ f. *tirikensis*: inner marginal area very pale, and basal triangle of *hobleyi* strongly marked below.

11. In forest (A), Nov. 3, 1912. ♀. A form of *tirikensis* closely approaching a typical western ♀ of *eurytus*. No. 324 on list. The only specimen of this W. African type taken in Uganda.

12. In forest, 1 mile E. of Oni, near Lagos, W. Africa, Dec. 11, 1910. W. A. Lamborn. One of the typical western females of *eurytus*; mimics 13. Represented for comparison with 11.

13. In clearing of Oni camp, near Lagos, Oct. 16, 1910. W. A. Lamborn. *Planema epaea*. ♀. Model for No. 12: it does not occur on Bugalla Island, and has never been taken in Uganda, where it is represented by the dingier *epaea paragea*. A single typical ♂ has however been taken on the far Western border of Uganda (Semliki Valley) by Sheffield Neave.



Alfred Robinson, photo *About $\frac{5}{8}$ of Natural Size.* *André & Sleigh, Ltd.*

Pseudacraea eurytus hobleyi, &c. Transition from *terra* to *impleta* (1—8), from *terra* to ♂ *hobleyi* (9), *terra* to *tirikensis* (10). *Tirikensis* (11), resembling a typical Western ♀ *eurytus* (12), mimetic of ♀ *Planema epaea* (13). (12) and (13) from Lagos, 1910 : W. A. Lamborn. (1—11), Bugalla Island, N.W. Victoria Nyanza, 1912 : G. D. H. Carpenter.

Explanation of Plate XXXV.

The figures are about $\frac{4}{7}$ of the natural size.

Three families of *Pseudacraea eurytus hobleyi*, Neave, with their female parents. An account of Series B (1–4), and E (5–8), is published in Trans. Ent. Soc., 1912, pp. 706–716; of Series J (9–16 in Proc. Ent. Soc., 1913, pp. ix–xi.

Fig. 1. ♀ parent of 2, 3, 4 (Series B). In forest (A), Bugalla Island, L. Victoria, June 30, 1912. (No. 120 in list, *q. v.*) Form *obscura*, ♀.

2. Offspring of 1. Emerged Sept. 3. Form *terra*, ♀.
3. Offspring of 1. Emerged Sept. 6. Form *obscura*, ♀. Fore-wing subapical bar whitish, a trace of golden suffusion on inner margin, hind-wings pale, with umber suffusion at base on underside. This is a transitional specimen. (See Proc. Ent. Soc., 1912, p. cxxxvi.)
4. Offspring of 1. Emerged Sept. 8. Form *terra*, ♀. A little white suffusion to subapical bar of fore-wing.
5. ♀ parent of 6, 7, 8 (Series E). At edge of forest (D), Bugalla Island, July 24, 1912. (No. 152 in list, *q. v.*) ♀ form *tirikensis*, the ♀ of the ♂ form *hobleyi*.
6. Offspring of 5. Emerged Sept. 28, 1912. Form *tirikensis*, ♀.
7. Offspring of 5. Emerged Oct. 4, 1912. A transitional form, ♀ *obscura*, with well marked basal umber suffusion.
8. Offspring of 5. Emerged Oct. 6. ♂. A transitional form, with golden suffusion of *terra* on *obscura* basis, hind-wings below show umber suffusion indicative of *hobleyi*.
9. ♀ parent of 10–16 (Series J). Same locality as 1, Oct. 13, 1912. (No. 296 in list, *q. v.*) ♀ form *tirikensis*.
10. Offspring of 9. Emerged Dec. 7. ♂ form *obscura*, suffused with a little of the yellow of *terra*.
11. Offspring of 9. Emerged Dec. 8. ♂ form *obscura*, suffused with a little of the yellow of *terra*.
12. Offspring of 9. Emerged Dec. 9. ♂ form *hobleyi*. The white hind-wing bar is tinted with yellow at its costal end.
13. Offspring of 9. Emerged Dec. 10. ♀ *obscura*.

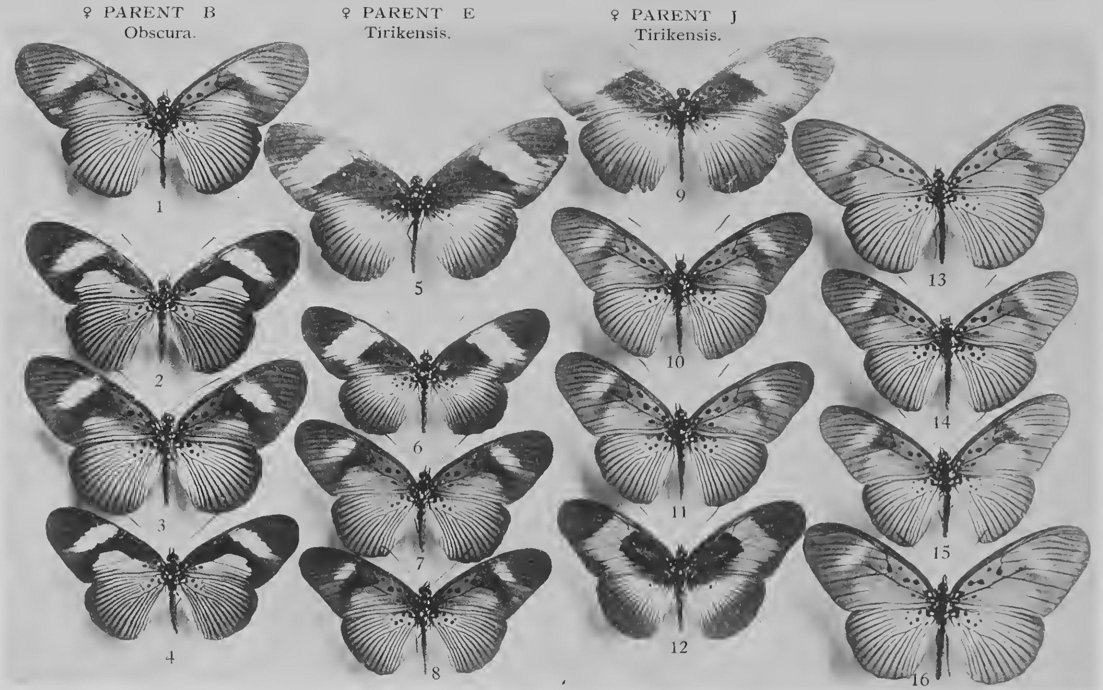
Explanation of Plate XXXV.

Fig. 14. Offspring of 9. Emerged Dec. 10. ♂ *obscura*, with a trace of *terra* like 10.

15. Offspring of 9. Emerged Dec. 9. ♂ *obscura*, with a trace of *terra* like 10.

16. Offspring of 9. Emerged Dec. 13. ♀ *obscura*.

In every specimen there is a marked umber suffusion at base of hind-wing under surface, derived from the parent form, *hobleyi*. An eighth member of this family, a typical ♂ *hobleyi*, failed to emerge.



Trans Ent. Soc., Lond., 1913. Plate XXXV.

Alfred Robinson, photo.

About 4/7 of Natural Size.

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Pseudacraea eurytus hobleyi. Three families with their female parents, shewing *terra* (2, 4) produced by *obscura* (1), and *obscura* (10, 11, 13-16), by *tirikensis* (9). Three others (3, 7, 8) are transitional between *obscura* and *terra*, (6) is *tirikensis* and (12) *hobleyi.* Bugalla Island, N.W. Victoria Nyanza, 1912 : G. D. H. Carpenter.

EXPLANATION OF PLATE XXXVI.

The figures are rather under half natural size.

Figs. 1–7 represent the chief *Planema* models from the forests in the neighbourhood of Entebbe, where all were collected by Mr. C. A. Wiggins, together with their mimics, shown in figs. 8–13 ("I. Congr. Internat. d'Ent.," 1910, vol. ii, p. 483).

FIG. 1. ♀ *Planema macarista.* Captured Aug. 14, 1909, by C. A. Wiggins, in the forest on the E. slope of Kitabi Hill (about 4000 ft.), about two miles N.E. of Entebbe. The chief model of 8 and of Combination II (p. 611). The ♀ *Pl. alcinoe* is a subordinate model of Combination II in Uganda.

2. ♂ *Planema macarista.* Captured Aug. 22, 1909, as fig. 1. The model of 9, and of Combination IB (p. 609).

3. ♂ *Planema poggei.* Captured July 11, 1909, as fig. 1. The model of 10, and of Combination IA (p. 609).

4. ♀ *Planema poggei.* Captured July 11, 1909, as fig. 1. The model of 10, and of Combination IA (p. 609).

5. ♂ *Planema tellus eumelis.* Captured Aug. 22, 1909, as fig. 1. The model of 11, 12, and of Combination III (p. 611).

6. ♀ *Planema tellus eumelis.* Captured Aug. 14, 1909, as fig. 1. The model of 11, 12, and of Combination III (p. 611).

7. ♀ *Planema epaea paragea.* Captured July 23, 1910, by native collector in the forest S.W. of Kitala Hill, about four miles N.E. of Entebbe. The model (with sexes alike) of 13 (with sexes alike), and of Combination IV (p. 612).

8. *Pseudacraea eurytus hobleyi,* ♀ form *tirikensis,* mimetic of 1, and captured at the same time and place.

9. *Pseudacraea eurytus hobleyi,* ♂ form *hobleyi,* mimetic of 2, and captured at the same time and place.

10. *Pseudacraea eurytus hobleyi,* ♀ form *poggeoides,* mimetic of 3 and 4. This ♀ form, with the pattern of 8 and nearly the colouring of 9, is relatively very rare in the Entebbe district, but rather less so in Damba and Bugalla. It becomes common to the E. of the Nile, where 1, the model of 8, is unknown, but where 3 and 4 persist. The figured specimen was captured by C. A. Wiggins in the same

locality as its models 3, 4, on July 18, 1909 ("I. Congr. Internat. d'Ent.," 1910, vol. ii, p. 486–7, *n.* 3).

FIG. 11. ♂ *Pseudacraea eurytus hobleyi*, ♂ ♀ form *terra*. Captured at the same time and place as 5, the male of its model.

12. ♀ *Pseudacraea eurytus hobleyi*, ♂ ♀ form *terra*. Captured at the same time and place as 6, the female of its model.

13. ♀ *Pseudacraea eurytus hobleyi*, ♂ ♀ form *obscura*. Captured by a native collector, July 30, 1910, in the forest on lake shore, E. of Kitala Hill about two miles N.E. of Entebbe (about 3800 ft.). Mimics 7. This mimetic form is not nearly so common in the Entebbe district as it is in the neighbouring islands in Lake Victoria.

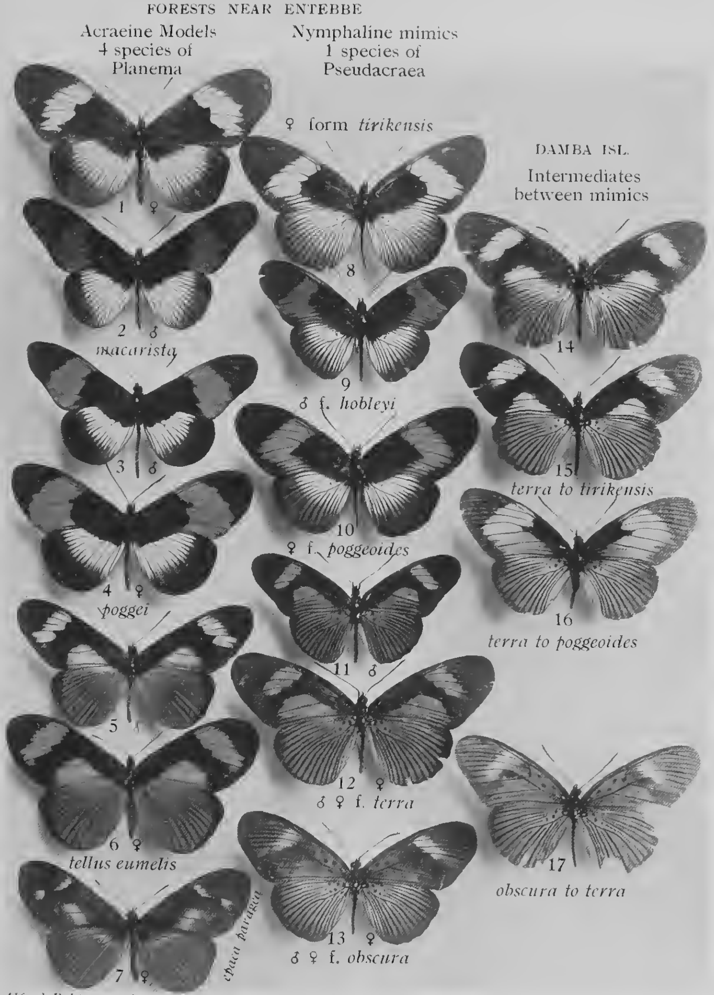
Figs. 14–17, all forms of *Ps. eurytus hobleyi*, intermediates between the forms 8–13. The examples figured were captured on the E. side of Damba Island, 1911 (Proc. Ent. Soc., 1911, pp. xci–v; 1912, pp. xix–xxiii). Transitional forms occur, but are relatively rare in the neighbourhood of Entebbe, where the models, 1–7, are much commoner than the mimics. They are relatively abundant on Damba and Bugalla, where mimics, resembling 8–13, are much commoner than the models.

FIG. 14. ♀ transitional between *terra* and *tirikensis*, the ♀ *hobleyi*. Captured July 1–15, 1911, on the shore.

15. ♀ transitional between *terra* and *tirikensis*. Captured Aug. 16–31, in deserted banana plantations, overgrown by jungle.

16. ♀ of the var. *impleta*, Grünb., transitional between *terra* and ♂ *hobleyi* or ♀ *poggeoides*. Captured, Dec. 3, along a game track in forest.

17. ♀ transitional between *obscura* and *terra*. Captured Sept. 17–30, in jungle similar to 13.



Alfred Robinson, photo.

Andre & Sleigh, Ltd.

Rather under ½ Natural Size.

Mimetic forms of the Nymphaline Butterfly *Pseudacraea eurytus hobleyi* and their Acraeine models from forests in the neighbourhood of Entebbe (C. A. Wiggins, 1909). Intermediates between the mimics from Damba Island, N.W. Victoria Nyanza, where the models are relatively scarce. (G. D. H. Carpenter, 1911).

NYMPHALINE MIMICS.					
Pseudacraea kuenowi hypoxantha ♂ ♀ mimics IA		Forms of *Pseudacraea eurytus hobleyi*		*Precis rauana*	
♂	♀	Serial number	♀ "*poggeoides*" mimicking IA ♂ "*hobleyi*" ,, IB ♀ "*tirikensis*" ,, II ♂ ♀ "*obscura*" ,, III ♂ ♀ "*terra*" ,, IV	♀ mimics I	♂ non-mimetic
1					
		356	♀ *tirikensis.*		

EXPLANATION OF PLATES XXXIV–XXXVI.

[*See Explanations facing the* PLATES.]

XXVI. Pseudacraea boisduvali, *Doubl., and its models, with especial reference to Bugalla Island.* By G. D. HALE CARPENTER, D.M., Oxon.

[Read November 5th, 1913.]

PLATES XXXVII AND XXXVIII.

THIS paper owes very much to the kind help and advice of Prof. Poulton, who is, indeed, the author of its being, for it would never have been undertaken except for his suggestion, nor carried through without his aid and advice. The arrangement of the plates is entirely due to him.

On Bugalla Island, in the Sesse Archipelago, Lake Victoria, during 1912 and January to February 1913, I was able to catch a good series of *Pseudacraea boisduvali*, Doubl., viz. 8 ♂♂ and 12 ♀♀. It frequents the forest, but is most easily caught when it comes to the edge to feed from the flowers of the bush *Haronga madagascariensis*, Chois. (*Hypericineae*), which particularly flourishes where the belt of forest suddenly comes to an end and is replaced by open grass-land. The single large bushes when in flower are extraordinarily attractive to many kinds of insects, and I have seen Planemas, and the forms of *Pseudacraea eurytus*, L., mimicking them, together with *Pseudacraea boisduvali* and various synaposematic red and black Acraeas (*A. egina*, Cram., *A. zetes*, L., and *A. perenna*, D. and H.), all together at the same time, with numerous other insects of the Lycoid synaposeme.

There is considerable difference of opinion as to the appearance of this fine *Pseudacraea* on the wing. Mr. G. A. K. Marshall wrote in 1897 (Trans. Ent. Soc., 1902, p. 504) as follows—" I feel quite satisfied that *Pseudacraea trimenii* [*boisduvali trimeni*] is a mimetic and not a protected species. In spite of its larger size it looks wonderfully like *Acraea acara* on the wing, and the first few examples I caught completely took me in. Their flight is like that of all Pseudacraeas and Euralias—slow and sailing —so long as they are not disturbed; but if struck at and missed they are off like a shot and do not often give one a second chance." The Rev. K. St. Aubyn Rogers, however, who has had experience of this species at Rabai, near Mombasa, is of a somewhat different opinion. In his "Bionomic Notes on British East African Butterflies" (Trans. Ent. Soc., 1908, p. 526) he says, speaking of the difference in flight between the model and the mimic: "Its flight is more lofty and sustained, and when alarmed it goes off at a great rate." This is exactly my own experience, and is the usual case with a mimic of the Nymphaline group: they seem to feel that their appearance will not bear close examination, and if pursued with intent will trust rather to their flight than to their appearance. (Cf. the note on *Precis rauana* in my paper on the *Pseudacraea eurytus hobleyi* group, pp. 610, 611). I have never been deceived by *boisduvali*, as I have by *eurytus hobleyi*. The *Pseudacraea* has a very much stouter appearance than its Acraeine model, which is a thin-bodied insect of comparatively feeble flight. When at rest on a flower-head the *Pseudacraea* is always on the alert and is difficult to catch, as it takes alarm before one gets within striking distance. The *Acraea*, however, if struck at, and missed, in most cases will return to the same spot.

Rogers (*l. c.*, p. 526) noticed that the integuments of the *Pseudacraea* are very tough, and I have noticed the same thing myself. Although the butterfly is not so resistant to a pinch on the thorax as is its model, yet it is certainly more resistant than *Pseudacraea eurytus hobleyi*, with which I have had a large experience.

If one compares the series of 8 males and 12 females from Bugalla Island (Plate XXXVIII, figs. 2, 6, 7, 8, 9, 10) with specimens from other parts of Africa (Plate XXXVII, figs. 2, 4, 11, 13), the island forms appear to be intermediate between the Eastern and South-eastern forms on the one hand and the West Coast forms on the other hand, and in this they agree with specimens caught by S. A. Neave on the mainland of Uganda—a male and a female from the N. shore of the lake near Kampala, and a male and two females from the W. shore in Buddu. Let us consider the *males* first.

The mimetic resemblance of the male Pseudacraea boisduvali both East and West.—In the Hope Collection at Oxford is a long series of the Eastern form, as follows, following an order from N. to S. :—

30 caught by the Rev. K. St. A. Rogers at Rabai, near Mombasa, Br. E. Africa.
1 caught by the Rev. H. Rowley, from "the Zambesi."
2 caught by C. F. M. Swynnerton in S.E. Rhodesia (Chirinda forest).
6 caught by G. A. K. Marshall in Natal.
1 caught by G. H. Burn in Natal.
22 bred by the late A. D. Millar at Durban, Natal.

These 62 males show that more than half of the Eastern examples have a well-developed orange-yellow subapical bar on the fore-wing (Plate XXXVII, fig. 11). This same peculiarity is well marked also in the model of the Eastern *boisduvali* (or *boisduvali trimeni*, Butl.), namely the *acara*, Hew., race of *Acraea zetes*, L. (fig. 10). In some males of *trimeni*, on the other hand, this bar has almost or quite disappeared (as in 5 from Mombasa, 4 from Durban, and 1 from S.E. Rhodesia), or else is very faintly represented by that part of it near the hind-margin of the wing (as in 9 from Mombasa and 6 from Durban). Subtracting these, we get 62 − 25 = 37, out of 62, with well-developed orange bar, so that this form is slightly predominant in the *East* and *South-east;* and specimens with a less but still fairly well-developed orange area are very common. In the specimens from *West* Africa, of which, however, there are only 2 males and 1 female in the Hope Department, this orange area hardly appears; the Sierra Leone specimen shows no trace of it (Plate XXXVII, fig. 2), and an Angola specimen only that end of it close to the hind-margin of the wing.

Now in the Uganda males (Plate XXXVIII, figs. 2, 6, 7), in *no* case is the orange bar so well developed as in the 37 Eastern males, and in only half of them is it in the same condition as in the Angola specimen. Hence, as regards the non-development of the orange bar, the Uganda males approach most nearly to the Western form. The Western form, as was first pointed out by Haase (see pp. 651, 652), mimics *Acraea egina* and not *Acraea zetes*, and the Uganda males also mimic *A. egina*, although *zetes* abounds on Bugalla Island.

There is another point of interest in the mimicry of the male *Acraea zetes acara* by *Pseudacraea boisduvali trimeni* (formerly *Ps. trimeni*, when the East African form was regarded as a distinct species). Many specimens of ♂ *zetes* from Natal, Rhodesia, etc., show a white irradiation of the centre of the hind-wing, and this is also present in a certain number of the Pseudacraeas from the same localities. This white irradiation has been beautifully shown in Eltringham's magnificently illustrated "African Mimetic Butterflies," Oxford, 1910 (Plate 6).

At Mombasa, in British East Africa, however, where the *zetes* are still of the Eastern form with a well-marked orange bar on the fore-wings, none of the Oxford specimens show the white irradiation, and neither do the *boisduvali*, save for the minutest trace along a few nervules, which is only visible on very close inspection, as in fig. 11, Plate XXXVII. In the photograph the white is more conspicuous than in the actual specimen.

Now let us turn to another point. The *Western* form of the male (which we may now call *boisduvali boisduvali* in contradistinction to the Eastern *boisduvali trimeni*), as illustrated by the two specimens in the Hope Department, shows, at the base of the fore-wings, a very marked suffusion with black, which replaces the red colour over approximately the basal half of the wing. This is particularly well shown in the specimen from Sierra Leone (Plate XXXVII, fig. 2), but the other, from Angola (Hewitson, 1873), which is in poor condition, does not show this so clearly. It may be remarked here that as we reach the more southern latitudes of the tropical West Coast an Eastern affinity begins to appear not only in *Ps. boisduvali* but in other species as well. The darkening of the fore-wing basal area is exactly the change most needed to produce a likeness to *Acraea egina*, which differs from *A. zetes acara*, amongst other less conspicuous points, in having the red colour on the fore-wing replaced by black over this very part of the surface. (Compare figs. 1 and 10 on Plate XXXVII.) Now, out of the whole number of specimens of the East African male *boisduvali trimeni* in the Hope Department, only one, taken by the Rev. K. St. Aubyn Rogers near Mombasa, Dec. 29, 1906, shows this black suffusion over the base of the fore-wing at all well marked. This was described as an interesting link between *trimeni* and *boisduvali* proper by Trimen in an appendix to Rogers' paper on the "Bionomics of East African Butterflies" in these Transactions, 1908, p. 552. But, on comparing the males from Uganda (8 from Bugalla Island and 2 from the mainland) one finds this basal black very well marked indeed in 6 of the 8 island specimens (Plate XXXVIII, figs. 2, 6, 7), and one of the two mainland specimens (from Kampala). In another island specimen, and the second mainland male (from Buddu) the basal suffusion is less marked, though it is nevertheless more pronounced than in the Eastern *trimeni* form. In the remaining island male the basal black is only just noticeable (as it is in one specimen bred by the late A. D. Millar in Natal and the one caught by Rogers near Mombasa).

If we then consider these two points, namely, the degree of development of the orange subapical area, and the basal black suffusion, the conclusion is irresistible that the ♂ *Ps. boisduvali* in Uganda (Plate XXXVIII, figs. 2, 6, 7) is intermediate between the *trimeni* form of the East with well-developed orange bar and no basal black (Plate XXXVII, fig. 11), and the true *boisduvali* form of the West, with no orange and well-developed basal black (Plate XXXVII, fig. 2), but that on the whole it is nearer to the latter and more closely resembles *Acraea egina*, the Western model, than *Acraea zetes*, the Eastern model, although, as I have said, *zetes* is plentiful enough on the island.

In testing this conclusion by comparing the figures on Plates XXXVII and XXXVIII, it is necessary to make allowance for the difficulty of representing black, red and orange in their full values by means of a plate prepared from a photograph, however good. By screening, long exposure, and sensitive plates, Mr. Alfred Robinson has produced very fine results, but the added advantage of colour is indispensable for the adequate representation of such butterflies as the forms of *Pseudacraea boisduvali* and their models.

As regards the red spots along the black margin of the hind-wing, the Bugalla Pseudacraeas come nearer to *zetes*, but this is a comparatively inconspicuous feature. It is an extraordinarily interesting thing that *boisduvali* should, on the West Coast, forsake its Eastern model for another species (a representative of which is present as *egina areca*, Mab., on the East Coast), although its Eastern model has a common Western form, *zetes zetes*. Large collections made without prejudice might explain this by showing that *egina* is predominant in the West as *zetes acara* certainly appears to be in the East, but this is yet to be done.

A further complication is introduced into this intricate question by the interrelation between the two species of *Acraea* themselves and their place in a large combination of dark fore-winged Acraeas in West Africa. In this combination *egina* is probably the predominant form, and has played the principal part in the Western modification of *zetes.* Thus, in the Western ♂ *zetes* (Plate XXXVII, fig. 5) the red area of the fore-wing is much contracted, resembling the smaller area of *egina* (fig. 1). Specimens of this kind occurred on Bugalla Island (fig. 7), some showing it even more markedly than the one figured. Others, however, were still of comparatively Eastern form (fig. 8), so that, on Bugalla Island, there was a true mixture of the two geographical races, as is so often found in Uganda where East and West *do* meet around the shore of the great Lake Victoria.

It may be noted that on Bugalla itself *egina* and perhaps *perenna,* D. and H., are the only Acraeas which are likely to have taken any part in the transformation of *zetes.*

It will be of interest here to note the gradual development of our knowledge of the relationship between *Pseudacraea boisduvali* and its Acraeine models. Trimen says, in an appendix to Rogers' paper mentioned above, 1908, p. 552: "in 1869 (Trans. Linn. Soc. Lond., xxvi, p. 517)," and later in 1887 and 1889 (" S. Afr. Butterflies," i, p. 298; iii, p. 405), " I showed how closely in both sexes *trimenii,* the South-Eastern form, copied *Acraea acara,* Hewits., of the same region, just as *boisduvalii* mimicked the West African *Acraea zetes,* Linn." Later on he continues (p. 553): " I am now able, . . . to record the occurrence in a British East African series . . . of a ♂ *trimenii* from 'Rabai, near Mombasa (K. St. A. Rogers) . . .,' in which the sub-apical bar of fore-wing is very much reduced and narrowed (while the red spots in the hind-marginal border of hind-wing are unusually large),—having the fore-wing fuscous suffusion largely developed, so that the usual red ground colour is obliterated except for a large sub-quadrate space at posterior angle as in *P. boisduvalii,* and a slight sub-basal trace. This example is a most distinctly intermediate link between the Western and Eastern forms . . ."

In a footnote he adds: " Haase (Untersuch. über die Mimicry, etc., 1893, p. 43, taf. 4, ff. 26–28) showed that *boisduvalii* mimicked *A. egina,* Cram., more closely than

A. zetes, at any rate as far as the ♂ is concerned, that sex having a red patch along outer portion of inner margin of fore-wing, just as in *egina* ♂, and larger than is exhibited by *zetes* ♂, while in hind-wing larger black spots characterise both *egina* and *boisduvalii*. On the other hand, as regards the presence of red spots in the hind-marginal border of hind-wing, *boisduvalii* resembles *zetes* and not *egina*."

Prof. Poulton alludes to this curious changing of resemblance to another model on the West Coast, in a note to Rogers' account of *Ps. trimeni*, as follows (*l. c.*, p. 528) :—

"There can be no doubt that the eastern sub-species *trimenii*, with its conspicuous subapical yellow-ochreous fore-wing bar, mimics *Acraea acara* (in which the apical portion of the fore-wing is warm reddish-ochre), and bears no very close resemblance to *areca* or to any of the other large red black-marked, eastern Acraeas. The western *boisduvalii*, on the other hand, is a much closer mimic of *Acraea egina*, the western representative of *areca*, than it is of *zetes*, the representative of the eastern model of *trimenii*. This is all the more remarkable because *zetes* is replaced by *acara* in the Cameroons, as I was astonished to find in the collection of the Brussels Museum.

"This mimetic relationship is unusual, and is all the more remarkable because the eastern mimic is transitional into the western, the eastern model into the western *zetes*, the western model into the eastern *egina*."

The mimetic resemblance of the female Pseudacraea boisduvali.—It is the mimicry by the Bugalla Isle female which finally clinches the evidence that the Western *Pseudacraea boisduvali* mimics *Acraea egina ;* for there exists on the island a peculiar variety of female *egina*, which is evidently drawing the local female *Pseudacraea* towards itself.

This island female of *A. egina*, named *alba* by Eltringham (Trans. Ent. Soc., 1913, p. 412), approaches very closely to the subspecies *medea* of Cramer, which is also an island form and at present only known from Prince's Island in the Gulf of Guinea. The female *medea*, Cram., is dull white with all the spots very large and prominent (Plate XXXVIII, fig. 5)

The Bugalla females of *egina* (figs. 3 and 4) only differ from *medea* in that the hind-wings are not so white but exhibit a very slight brownish tint, so that they are to some extent intermediate between the typical *egina* and the Prince's Island form. On the lower surface, the wings show a little more yellowish tint than in the true *medea*, in this also being intermediate between the type and this subspecies.

Unfortunately I only caught four specimens, not realising at the time the interest attaching to them, so that I cannot show from my own experience that they are the only form of female *egina* on Bugalla Island. That they are the only form is also indicated by Grünberg (Trans. Ent. Soc. Lond., 1913, p. 412), and I hope to put the matter beyond doubt on my return to Bugalla; for *egina* is an abundant species there. I was struck with the general likeness of this pale form to *Planema consanguinea albicolor*, Karsch (*arenaria*, E. M. Sharpe), when seen at a little distance on a flower head.

Now the Bugalla females of *Pseudacraea boisduvali* are also peculiar in the large development of a white suffusion on the fore-wings. This varies much in degree in the twelve specimens, but in that which shows it best (Plate XXXVIII, fig. 10) there is a white subapical area, and much of the basal half of the fore-wing is whitish, a pinkish tint being confined to the base. The hind-wings are of a dull brownish, like those of a typical ♀ *egina*, but there is a whiter patch on the anterior margin. The likeness of this specimen to its model (Plate XXXVIII, figs. 3 and 4) is further accentuated by the row of heavy black spots just internal to the subapical white patch on the fore-wing. These spots are only just indicated in the other specimens (figs. 8, 9), but they form a characteristic marking of the model.

In none of the 12 Bugalla females is there the large *yellow* subapical patch which is a conspicuous feature of the Eastern ♀ *boisduvali*, which resembles *Acraea zetes acara*, though in 9 of them the white patch which takes its place has a trace of yellow suffusion at the hind-marginal end.

In these points they agree with Neave's 3 specimens from the mainland of Uganda. None of Neave's, however, show the white suffusion over the base of the fore-wing, so characteristic of the Bugalla specimens, and not shown in any of the 39 Southern and Eastern forms. The *Western* female of *boisduvali* is represented in the Hope Department by two specimens, one of which comes from Sierra Leone, and was purchased in 1901 from Watkins and Doncaster. In this (Plate XXXVII, fig. 4), which mimics the *typical* female *egina* (fig. 3), the fore-wings are grey-brown with neither white nor yellow subapical area, and only a faint trace of pinkish brown suffusion at the anal angle. The hind-wings are red brown, resembling those of the *egina* female. The second Western ♀, taken by Neave in the S.E. of the Congo State, about 150–200 miles W. of Kambove, in 1907, has the typical appearance of an Eastern female. This is in accordance with the affinities displayed by other species from the same area.

The conclusion is that the female, as well as the male, *Pseudacraea boisduvali*, of Bugalla Island, L. Victoria, follows the typical Western form in mimicking *Acraea egina* instead of *Acraea zetes*; the evidence being peculiarly convincing because the ♀ *egina*, but not the ♀ *zetes*, appears as a striking local form which is mimicked by the ♀ *Pseudacraea*. In the male the resemblance to the model is not quite so perfectly developed as in the Western form, it being intermediate between that and the Eastern form, although much nearer to the former, as in certain other Uganda species which range from East to West.

Addendum.

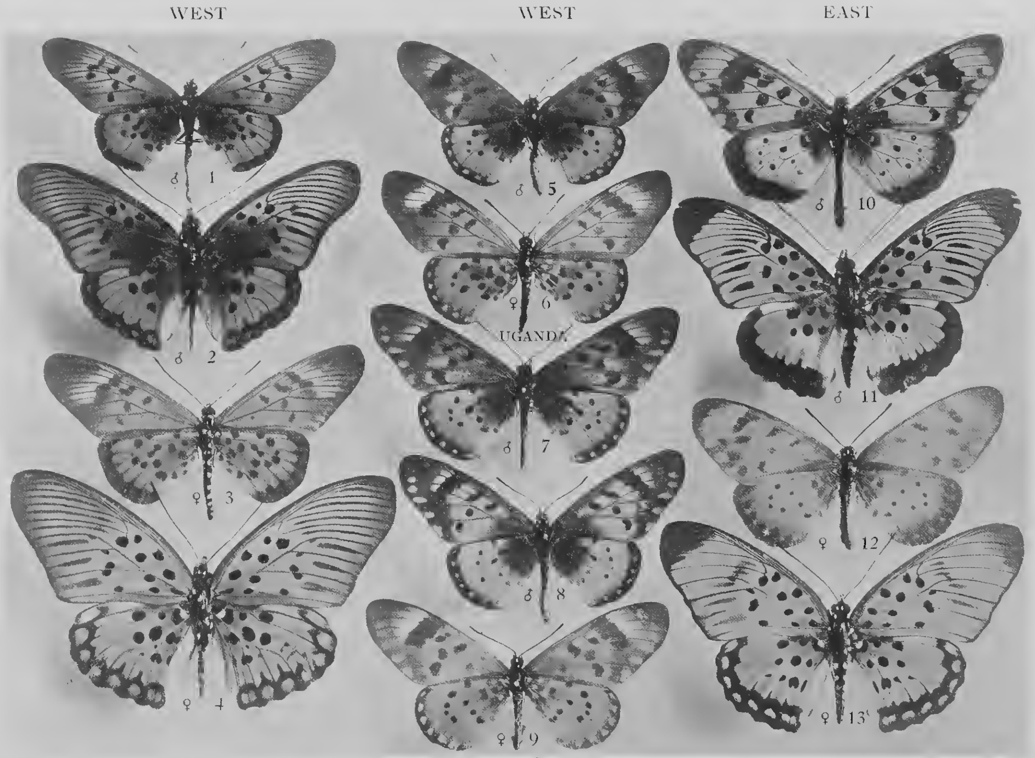
Since writing the above I have had, through the kindness of Mr. Roland Trimen, F.R.S., an opportunity of examining the *Ps. boisduvali* in his private collection, containing a fine series of specimens bred in 1910 by the late A. D. Millar, at Durban.

In this series there are 12 males and 13 females.

Of the 12 males, 6 were of the typical, highly-coloured Eastern form with very conspicuous large orange-yellow subapical area on the fore-wing. In 4 males the orange area was smaller, and from two only was it absent. One of the specimens with much orange had well-defined black suffusion over the base of the fore-wing, but none of the others exhibited any signs of this.

Of the 13 bred females, 10 were of the typical Eastern form, with well-marked orange areas on the fore-wing; the other 3 had the yellow much reduced, or whitish in colour.

Mr. Trimen also has 2 females, caught, one in Zululand and one at Malvern in Natal. These are typically Eastern, and one has a very slight suffusion with white on the hind-wing about the centre.



Trans. Ent. Soc. Lond., 1913. Plate XXXVII.

Alfred Robinson, photo.

Slightly under ⅔ of Natural Size.

André & Sleigh, Ltd.

Mimicry in the Western (2, 4) and Eastern (11, 13) races of the Nymphaline, *Pseudacraea boisduvali*. Resemblance between the Western Acraeas, *egina* (1, 3)—the model of Western *boisduvali*—and *zetes* (5, 6). Affinity of Uganda (Bugalla I.) *zetes*—Western (7, 9), and transitional (8) towards the Eastern *zetes acara* (10, 12)—the model of Eastern *boisduvali*.

EXPLANATION OF PLATE XXXVII.

The figures are slightly under ⅔ of the natural size.

The Western and Eastern races of the Nymphaline butterfly *Pseudacraea boisduvali*: its Acraeine models, *Acraea egina*, Western, and *A. zetes acara*, Eastern. Resemblance between *egina* and *zetes* in the West. Western and intermediate affinities of the Uganda (Bugalla Isle) *zetes*.

All the examples figured here and on Plate XXXVIII are in the Hope Department, Oxford University Museum.

FIG. 1. *Acraea egina* ♂. W. A. Lamborn. Oni camp, nr. Lagos, between Dec. 1, 1908, and Dec. 3, 1909. The model for 2.

2. *Ps. boisduvali boisduvali* ♂. Sierra Leone (Watkins and Doncaster). Mimics 1.

3. *Acraea egina* ♀. W. A. Lamborn. Oni camp, nr. Lagos. Bred June 29, 1910. Model for 4.

4. *Ps. boisduvali boisduvali* ♀. As male fig. 2. Mimics 3.

5. *Acraea zetes* ♂. W. A. Lamborn. Larva in forest nr. Oni camp, nr. Lagos. Bred June 23, 1910. Pupated June 14. This shows the Western form of *zetes*, approaching *egina* (cf. 1).

6. *Acraea zetes* ♀. As 5 for data.

7. *Acraea zetes* ♂. G. D. H. Carpenter. Open grass-land on Bugalla Island, L. Victoria, nearly 4000 ft. above sea-level. First half Sept. 1912. Shows the Western type of *zetes*, approaching 5, but not so completely as some other specimens from the island.

8. *Acraea zetes* ♂. Same locality and captor as 7. This approaches more closely the Eastern type *zetes acara*, but has only a trace of the ochreous subapical tint.

9. *Acraea zetes* ♀. Same locality and captor. Taken *in coitû* with a male like 7.

10. *Acraea zetes*, subspecies *acara*, ♂. Rev. K. St. Aubyn Rogers, Rabai, 14 miles N.W. of Mombasa, 700 ft. above sea-level. May 22, 1909. Thoroughly Eastern type. Model for 11.

11. *Ps. boisduvali trimeni* ♂. Same locality and captor as 10. July 15, 1911. Mimics 10.

12. *Acraea zetes* ♀, subspecies *acara*. Same locality and captor. April 24, 1906. Model for 13.

13. *Ps. boisduvali trimeni* ♀. Rev. K. St. A. Rogers. Ndzovuni, 25 miles North of Rabai. Dense forest, 300–600 ft. June 10, 1911. Mimics 12.

EXPLANATION OF PLATE XXXVIII.

The figures are slightly under $\frac{2}{3}$ of the natural size.

The Nymphaline butterfly *Pseudacraea boisduvali* and its Acraeine model *Acraea egina* on Bugalla Isle, Lake Victoria, nearly 4000 ft. above sea-level.

The males of both model and mimic are of the Western type of pattern. The female model is a remarkable pale form peculiar to the island, but recalling the female of Prince's Island in the Gulf of Guinea. The Bugalla females of the mimic exhibit various degrees of approach to the pale *egina* females.

All the examples here represented, except that shown in fig. 5, were captured by G. D. H. Carpenter.

FIG. 1. *Acraea egina* ♂. Open grass-land, June 7–14, 1912. The model for 2, 6, 7. Pattern resembles that of Western male (Plate XXXVII, fig. 1).

2. *Ps. boisduvali* ♂. Forest edge, lake shore, March 12, 1912. Mimic of 1: the pattern is more Western in character than 6 and 7 in the almost complete absence of the subapical bar of the fore-wing.

3. *Acraea egina* ♀ form *alba*, Eltringham. Forest edge, Aug. 9, 1912.

4. *Acraea egina*, ♀ form *alba*. Forest edge, Aug. 16. 1912.

Figs. 3 and 4 are the models for 9 and 10. These are two of the four *alba* forms alluded to in the text which so very closely approach 5, and differ from the Western mainland female (Plate XXXVII, fig. 3.)

5. *Acraea egina*, subspecies *medea*, Cram., ♀. Prince's Island, W. Africa, March 30, 1901.

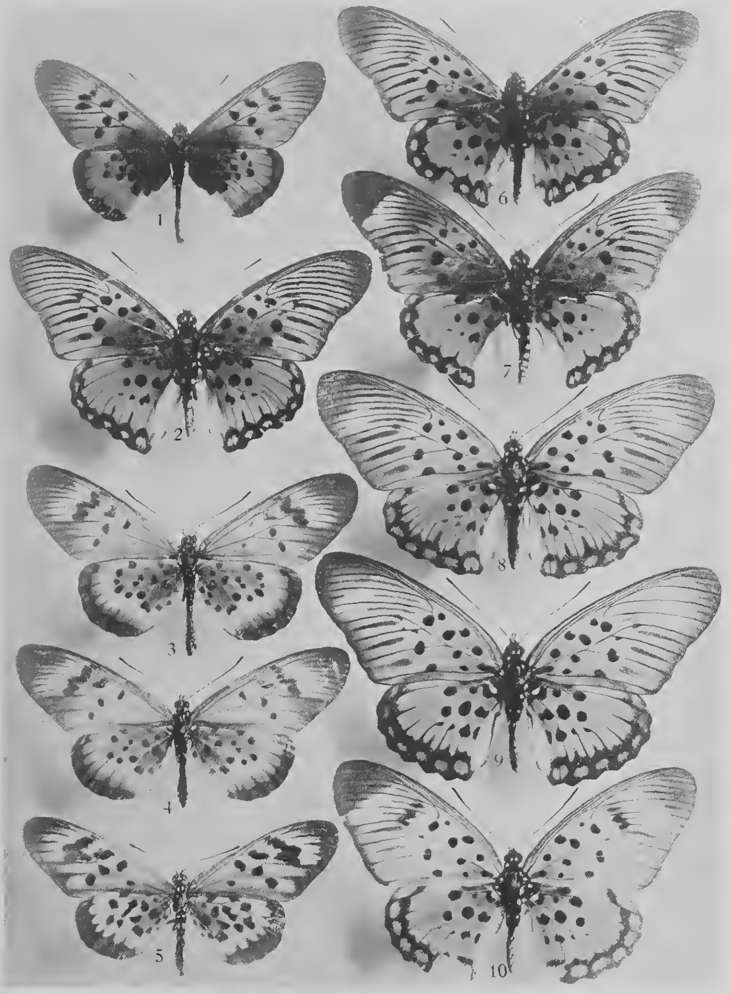
6. *Ps. boisduvali* ♂. Forest edge, Dec. 24, 1912. Mimic of 1. Intermediate between 2 and 7.

7. *Ps. boisduvali* ♂. Forest edge, Sept. 5, 1912. An interesting transitional male: it has the yellow subapical area, which is much more developed in the Eastern *trimeni* form, but possesses also the basal black suffusion of the Western form, the true *boisduvali*. It thus combines Eastern and Western characters. Cf. 2 and 6.

8. *Ps. boisduvali* ♀. Forest path, Jan. 5, 1913. The specimen which comes nearest to the typical Western form, having no white suffusion and very little pink suffusion over the brown.

9. *Ps. boisduvali* ♀. Forest path, March 10, 1912. This specimen, intermediate between 8 and 10, shows a moderate amount of white suffusion, mimicking 3 and 4.

10. *Ps. boisduvali* ♀. Forest edge, lake shore, Sept. 27, 1912. This one, of all the females, best shows the white suffusion which produces likeness to 3 and 4.



Alfred Robinson, photo.

André & Sleigh, Ltd.

Slightly under $\frac{2}{3}$ of Natural Size.

♂ *Pseudacraea boisduvali* (2, 6, 7) with Western pattern, only slightly transitional towards Eastern race, and mimicking ♂ *Acraea egina* (1) with Western pattern. ♀ *boisduvali* (8, 9, 10), mimicking remarkable white Bugalla ♀ *egina alba* (3, 4)—a form recalling the ♀ *egina medea* (5), Prince's I., Gulf of Guinea. All except (5) Bugalla Island, N.W. Victoria Nyanza : 1912. G. D. H. Carpenter.

Of the captured males, there are 5 typically Eastern (all from Malvern in Natal), two having some white on the hind-wing. In 2 others from Malvern the yellow on the fore-wings is reduced, and in 2 more there is no yellow, one of them having very slight black suffusion over the base of the fore-wing. In both, the marginal red spots on the hind-wing are rather large. These are transitional forms between typical E. and W. specimens.

EXPLANATION OF PLATES XXXVII AND XXXVIII.

[*See Explanations facing the* PLATES.]

XXVII. *The inheritance of small variations in the pattern of* Papilio dardanus, *Brown.* By G. D. HALE CARPENTER, D.M., Oxon.

[Read November 5th, 1913.]

PLATES XXXIX AND XL.

THE work of which this paper is an account was undertaken, at the suggestion of Prof. Poulton, in regard to my family of *P. dardanus* bred from ova laid by a parent of the form *planemoides*, Trim., and exhibited at the meeting of this society on June 4, 1913 (Proceedings, pp. liii–lvi). The resulting female offspring—3 *planemoides* and 7 *hippocoön*, F. (Plate XXXIX), suggested very strongly that the influence of the pattern of the parent is communicated to the pattern of the offspring of a different type. In order to prove this, careful measurements were made of the large divided white spot in the cell of the fore-wing of the 7 *hippocoön* forms, which was in most cases sharply marked and easy to measure. This spot is represented in the *planemoides* form by an orange area in the corresponding position, which at its outer end is not sharply marked, but continuous with the broad orange area forming the band across the fore-wing (Plate XXXIX, figs. 1, 4, 6). In fig. 8 it is seen that part of the orange area in the cell has become separated off, as in *hippocoön*. The spot was measured from the middle of its base at the costa to the extreme tip (often placed on a detached portion), along its longitudinal axis which, if prolonged, leads to the base of a nervure.

[The origin of vein 5 (radial 2) is nearest to the point where the prolonged axis of the spot cuts the end of the cell, and there is little doubt that this is the vein to which the author measured. The marking is often more highly developed on the under surface, and it is there seen that the prolonged spot abuts against the lower or inner marginal half of the middle disco-cellular.—E. B. P.]

Inasmuch as the actual size of the spot will vary, *absolutely*, because of the different size of the individual butterflies, it is necessary to have a common standard by which a small butterfly can be compared with a larger one. This standard was obtained by expressing the length of the spot as a fraction of the distance from the base of the spot to the base of the nervure [vein 5] along the same axis. The resulting figures are given in percentages; and the different values express the relation between one specimen and another. In one case (Plate XXXIX, fig. 9), the percentage was 102, the spot being so large that its apex extended beyond the cell. The measurements of the spots on *both* fore-wings were taken, and the *average* used for the calculation, as it was found that there were often slight differences between the two sides. By the use of needle-pointed adjustable "dividers" it was found quite practicable to get as near as 0·25 of a millimetre.

It at once became obvious on comparing measurements of the *hippocoön* offspring (Plate XXXIX) derived from *planemoides* with 6 other broods (A–F) of *hippocoön* bred by Mr. W. A. Lamborn near Lagos, W. Africa, from *hippocoön* parents (see A, D, and E on Plate XL), that in the former brood the spot is uniformly large, and that in the latter the specimens are grouped together round a certain average size, which is never so large as the average in the 7 offspring of *planemoides*, and varies for each family. (See *Chart* on p. 663.)

This grouping is very well shown indeed in Brood A, in which the parent and fourteen offspring (Plate XL, figs. 1–15) all fall between the figures 50 and 59·5. In other families, although the majority of specimens fall well together there are a few outlying members, but the highest member of any family only comes up to the lower members of the family from the *planemoides* parent (Plate XXXIX). It is impossible to avoid the conclusion that the large size of the spot in the *hippocoön* offspring of *planemoides* is due to the influence upon them of the large size of the corresponding area in the parent, *whose pattern, however, is of quite a different type.*

If the photographs of the three *planemoides* offspring (Plate XXXIX, figs. 4, 6, 8) be compared with *hippocoön* (figs. 2, 3, 5, 7, etc.), an interesting point becomes apparent. Fig. 8, and to a less extent figs. 4 and 6, show in the apical half of the fore-wing a pattern very close to that of *hippocoön*. Fig. 8 in particular exhibits features like those of fig. 9, in which the outer part of the intracellular spot runs out to join the large subapical patch. This latter area in the *photograph* of fig. 8 is quite clearly differentiated from the rest of the orange band in the fore-wing, but if one looks at the *specimen* this difference is not so marked. There is therefore some difference in the two parts of the orange band more clearly perceived by the photographic plate than by the human eye. Fig. 8 enables one to realise more clearly how the pattern of the more typical *planemoides* form such as 4 and 6 can influence the *hippocoön* form, and cause the intracellular spot to be of larger size than usual. The pattern of *hippocoön* may be similarly recognised on the under surface of the 3 *planemoides* offspring, where, indeed, the demarcation between the paler orange of the subapical bar of the former pattern is rather more distinctly marked off from the darker orange of the latter than on the upper surface, the junction between the two tints, as it obliquely crosses area 4 (between veins 4 and 5), being faintly emphasised by a slightly deeper shade of the same colour.

Prof. Punnett, F.R.S., in the July number of "Bedrock," 1913, protests "against Prof. Poulton's assumption that any small variation may be inherited," and says "in no clear case has it been shown to exist."

The specimens just mentioned seem to constitute a pretty clear case in which quite a small and relatively unimportant part of the whole pattern of one type derives its unusually large size by heredity from the corresponding area, much larger and less well-defined in shape, of a parent whose pattern is quite different.

Not only is the average size of the spot in the seven specimens under consideration larger than the average of any other brood, but individuals have a larger spot than any of the specimens in the Hope Department from all parts of Africa.

It may be said that it is not fair to compare the *planemoides* family with Mr. Lamborn's families, because W. African specimens have *all* the white areas of the wing contracted in size, thus following their model *Amauris niavius*, L., whose Western form has smaller white areas than the Eastern form *dominicanus*.

An answer to this is provided by the *dardanus* families reared at Durban in Natal by Mr. G. F. Leigh, as well as by the other examples from S.E. Africa; for it will be shown on p. 662 that the average length of the spot in all these *hippocoön* is actually less than that of the

W. African *hippocoön*, although the rest of the pattern is larger. In other words, the spot varies independently of the rest of the pattern.

The Natal families reared by Mr. G. F. Leigh were discussed in great detail by Prof. Poulton in a paper on "Heredity in six families of *P. dardanus*, Brown, subsp. *cenea*, Stoll" (Trans. Ent. Soc., 1908, p. 427), in which the same spot now under discussion was considered, not from the point of view of its size, but as to whether it was divided in two or not. It was shown (*loc. cit.*, p. 444) in one family (No. 5) bred from a *cenea* parent in which this spot was divided, that 9 out of 14 *cenea* offspring also had the spot divided, as also in the only *hippocoön* offspring. Compare this with Family 4 in the same table, and it is seen that the parent *hippocoön* had the spot undivided, and this was also the case in 5 out of 8 *cenea* offspring, 2 out of 3 *hippocoön* offspring, and all of the 3 *trophonius* offspring.

And yet Prof. Punnett says that in no clear case has the inheritance of small variations been shown to exist!

In view of this statement attention may be redirected to sundry papers of Prof. Poulton on this very point as exhibited in the species under discussion. I have shown how the influence of the pattern of a *planemoides* parent is felt by the offspring of the *hippocoön* form as regards *size* of a certain spot. In the Trans. Ent. Soc., 1906, pp. 283, 313, Prof. Poulton shows that the influence of the *colour* of the parent form *trophonius* is felt by offspring of *cenea* form; and again in the Proc. Ent. Soc., 1911, p. xxxvii, he says with regard to another family: "Several of the *cenea* offspring exhibit the influence of the *trophonius* parent in the richer, deeper tinge of the basal patch of the hind-wing."

Again, in Trans. Ent. Soc., 1908, p. 436, he shows how the influence of a parent form *hippocoön* is exhibited in the colour of the *cenea* offspring.

[Since Dr. Carpenter's return to Africa I have observed the following examples of the inheritance of small features that can be made out by a careful comparison between the patterns of the three families represented on Plate XL.—E. B. P.]

(1) Parent D (fig. 16) differs from E (31) in having a larger white area on the hind-wing. This area in its offspring as shown in 17–21 and 30, is larger than in E's

offspring, as shown in 32, 33 and 28. (See also Proc. Ent. Soc., 1912, p. cxxxii.)

(2) The same area is also of a different shape in the two parents, being rounded in E, squarish in D, differences that are clearly recognisable in their respective offspring as shown on Plate XL.

(3) The triangular white patch on the inner margin of the fore-wing is larger, has a more flattened apex, and a longer base in D and its 14 offspring, than in A (fig. 1) and its 14 offspring.

(4) Of the two small spots at the costal end of the sub-apical white bar crossing the fore-wing, the basal one is minute and the outer large in A and most of its offspring, while in none of them is the basal spot as large as the outer. In E on the other hand the basal spot is relatively large and the outer absent: in 6 out of its 7 offspring the basal spot is relatively large as compared with nearly all the offspring of A; while in one (fig. 33) this feature is nearly as in the parent, although the outer spot is represented by a small dot. In the *planemoides* parent (Plate XXXIX, fig. 1) and most of its offspring these two spots are about equal in size, and in only one (fig. 11) is there a wide difference between them.

(5) Other features peculiar to the families, but unrecognisable in the parents, because of their poor condition, are also almost certainly hereditary. To this category belong figs. 10, 12, 13, and 14, in which the white area on the hind-wing is increased by a circumferential greyish extension, giving to the outline a peculiar and characteristic appearance (Proc. Ent. Soc., 1912, pp. xvi, xvii).

Measurement of all the specimens of *hippocoön* in the Hope Department (242) produced interesting results. The West African type is represented by one from Cape Coast Castle, one from "Tropical W. Africa" (Doncaster), 3 from "W. Africa" (Saunders), and 77 (38 shown on Plate XL) caught or bred by Mr. W. A. Lamborn in the vicinity of Lagos. The average ratio of the spot to the cell in these 82 specimens is 64 %—individuals going as low as 44 % and as high as 86 %, with every intermediate grade.

Passing eastward we come to the Western Uganda specimens with which I have included those from a few localities much further east, but always westward of Entebbe:—The "N. W. shore of L. Victoria"—3 specimens;

"Buddu, W. shore of the Lake"—7 specimens; Toro—5 specimens; Unyoro—1 specimen; "neighbourhood of L. Wamala"—1 specimen; the Semliki valley—1 specimen.

These 18 specimens, all collected by Mr. S. A. Neave, seem rather a heterogeneous lot, but the average size of the spot is practically the same as in the West Coast forms, viz. 65·2 %. Individuals range between 39·7 % and 86·9 %.

From the northern shore of the lake in the neighbourhood of Entebbe, from the islands, and from the neighbourhood of Kisumu on the Eastern shore come altogether 85 specimens. From Entebbe Mr. C. A. Wiggins sent 55 specimens, and Mr. Sheffield Neave contributed 8, and 5 more from Kampala. There is a single specimen from the Mabira forest (Wiggins) and 8,—seven of them represented on Plate XXXIX—from Bugalla Island (G. D. H. Carpenter).

From the neighbourhood of Kisumu on the E. shore of the lake come 7 specimens contributed by C. A. Wiggins and one by A. Vincent. These specimens are included with those from Entebbe rather than with the other specimens from E. Africa which are of the subspecies *tibullus*, Kirby, and come from localities far removed from the E. shore of the lake.

The average for these 85 specimens is not far from the West Coast average: but there is a greater range of variation, viz. from 38 % to 102 % (Plate XXXIX, fig. 9). Passing eastwards we come now to the locality of the subspecies *tibullus*, Kirby, and *polytrophus*, Jordan. These are represented by 11 *hippocoön* caught by K. St. A. Rogers near Mombasa, 2 by the same collector on the slopes of Kilimanjaro, 1 from Taveta by C. A. Wiggins, 4 from Kikuyu Escarpment by W. Doherty (these latter belong to the subspecies *polytrophus*), and a single specimen (Doncaster) from German East Africa. I have also included in this group, perhaps unjustifiably, a single specimen collected by S. A. Neave in Eastern Usoga, in the far E. of Uganda, whose spot-cell ratio was 78·2 %. The average figure for these 20 specimens is 78 %, and they are a fairly uniform lot, all coming between 71·4 % and 90·5 %, with the exception of one at 62·5 %.

There is another fine series of the subspecies *tibullus* collected by C. F. M. Swynnerton at Chirinda, Gazaland, S.E. Rhodesia. These 21 specimens have an average spot-cell ratio of 80 %, and are also a very compact group, ranging from 70·4 % to 91·2 %.

Finally the *hippocoön* form of the Southern race of *dardanus* is represented in the Hope Department by 12 specimens from the neighbourhood of Durban caught or bred by G. F. Leigh; one from Malvern, Natal, by G. A. K. Marshall; one from Cape Colony near King Williamstown, by J. P. M. Weale.

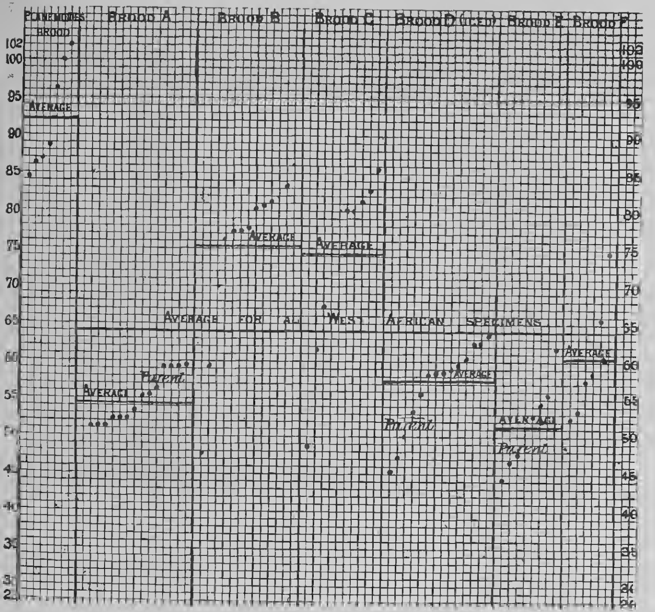
It must be remembered that the *hippocoön* of the S.E. coast has the main white areas on fore- and hind-wings *larger* than in the West Coast forms, corresponding to the *dominicanus*, Trim., form of its model *Amauris niavius* in E. Africa. Unfortunately, owing to the mixed character of the offspring from a parent in Durban, the number of *hippocoön* females in any family is small. The figures are as follows: From a *hippocoön* parent, whose spot-cell ratio was 68·3 %, there were three *hippocoön* forms, the figures for which were 60 %, 56·7 %, 47·2 %. From a *trophonius*, Westw., parent there were only two *hippocoön* offspring, whose figures were 52·9 % and 54·5 %. From a *cenea*, Stoll, parent two *hippocoön* offspring, 58·6 % and 64·5 %.

Since writing the above I have had an opportunity, through the kindness of Mr. Roland Trimen, F.R.S., of measuring the spot in five specimens in his private collection —3 from Natal and 2 from Cape Colony. These 19 Southern specimens range from 47·2 % to 77·5 %, with an average ratio of spot to cell of 61·2 %. It will be seen that the comparison of the average size of the West African spot with that of the Southern and Eastern form suggests a point of considerable importance to the argument developed in this paper. The *hippocoön* of Natal, which mimics *Amauris niavius dominicanus*, has the important white areas of the wings *larger* than in the *hippocoön* of the West Coast, mimicking *Amauris niavius* in which the white areas are also smaller than in the Eastern model. But the intracellular white spot, which is not of so much importance for the mimetic likeness, is, on the *average*, actually *smaller* in the Natal and Cape Colony forms than in the West Coast forms.

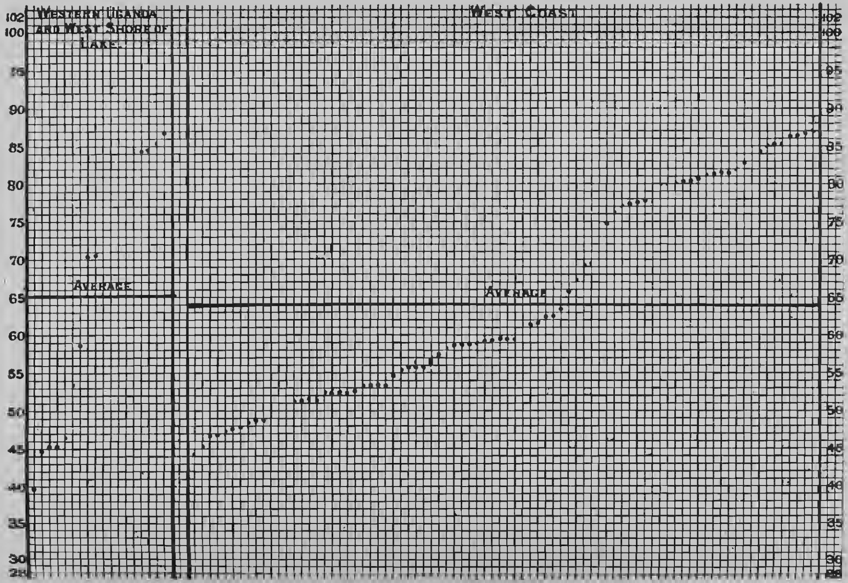
The above-described relationship disposes of an argument which might be stated against the conclusion here drawn (that the large size of the spot in *hippocoön* derived from *planemoides* is due to the hereditary influence of this small feature), namely the objection that the size of the spot in the *hippocoön* offspring is not due to a separate factor, but simply part of the general scheme of enlarged white areas in the Southern and Eastern form as compared with the Western.

But the spot is, on the average, actually smaller in the Natal forms than in the Western forms, whereas the reverse in the case with the large white areas which are of most importance for the mimetic resemblance. Furthermore the 7 *hippocoön* offspring of the female *planemoides*, like the other examples of *hippocoön* from Uganda, belong to the Western and not to the Eastern type; and yet the spots of these 7 specimens are the largest of all.

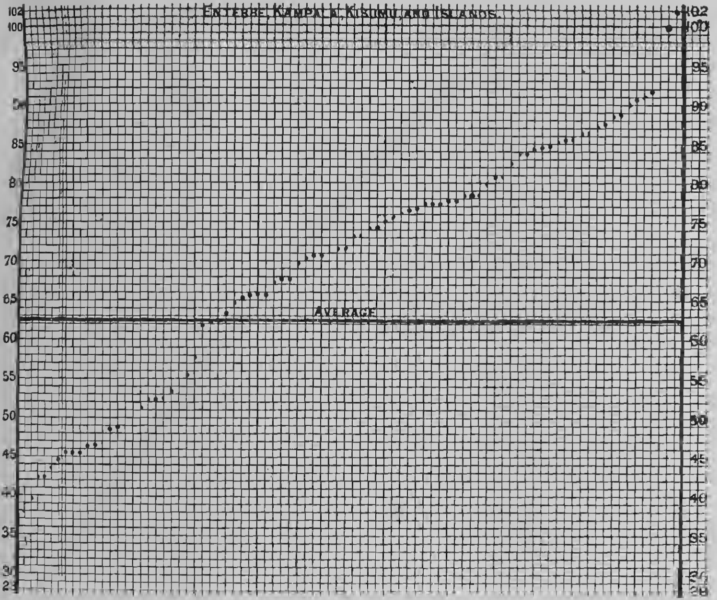
SPOT-CELL-RATIO IN *HIPPOCOÖN* OFFSPRING FROM A *PLANEMOIDES* PARENT (BUGALLA ISLAND) AND FROM SIX *HIPPOCOÖN* PARENTS (LAGOS DISTRICT).



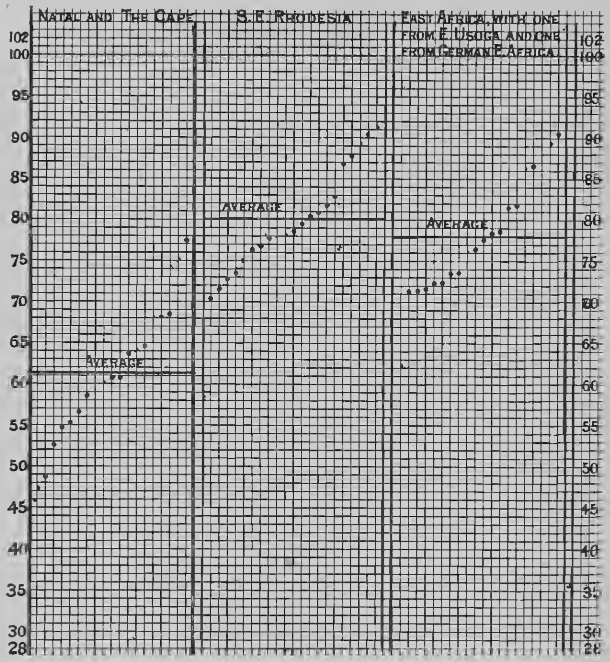
Spot-cell-ratio in *hippocoön* from West Coast, W. Uganda, and W. shore of Victoria Nyanza.



SPOT-CELL-RATIO IN *HIPPOCOÖN* FROM ENTEBBE, KAMPALA, ISLANDS IN N.W. VICTORIA NYANZA, AND KISUMU.



Spot-cell-ratio in *hippocoön* from East Africa, S. E. Rhodesia, and S. Africa.



Explanation of Plates XXXIX and XL.

[*See Explanations facing the* Plates.]

EXPLANATION OF PLATE XXXIX.

All figures are about half of the natural size.

Females,—3 *planemoides* and 7 *hippocoön*—and one of the 12 males bred by G. D. H. Carpenter from a *planemoides* female, also represented in the Plate, captured on Bugalla, Sesse Archipelago, N.W. of Lake Victoria, Dec. 1, 1912.

The specimens represented here and on Plate XL are in the Hope Department, Oxford University Museum.

The *hippocoön* offspring are seen to resemble their *planemoides* parent in the great length of the marking in the cell of the fore-wing, and to contrast in this respect with the *hippocoön* figured on Plate XL.

The order of the figures 2–12 does not correspond with the order of emergence from the pupae, which was as follows:—First 2 and 4; then 6 and 12; then 3; then 5, 7, 8, and 10; then 9; lastly 11.

FIG. 1. Parent *planemoides*, captured in forest Dec. 1, 1912.
2. *Hippocoön*, emerged Jan. 23, before dawn; pupated Jan. 8, 1913.
3. *Hippocoön*, emerged Jan. 24, about 9 a.m.; pupated Jan. 8.
4. *Planemoides*, emerged Jan. 23, before dawn; pupated Jan. 8.
5. *Hippocoön*, emerged Jan. 25, before dawn; pupated Jan. 9. The subapical spot is minute and only present on the right side.
6. *Planemoides*, emerged Jan. 24, before dawn; pupated Jan. 9.
7. *Hippocoön*, emerged Jan. 25, before dawn; pupated Jan. 9.
8. *Planemoides*, emerged Jan. 25, before dawn; pupated Jan. 9.
9. *Hippocoön*, emerged Jan. 25, 3 p.m.; pupated Jan. 9.
10. *Hippocoön*, emerged Jan. 25, before dawn; pupated Jan. 9.
11. *Hippocoön*, emerged Jan. 28, before dawn; pupated Jan. 12.
12. Male, emerged Jan. 24, before dawn; pupated Jan. 8.

Explanation of Plate XXXIX.

All figures are about half of the natural size.

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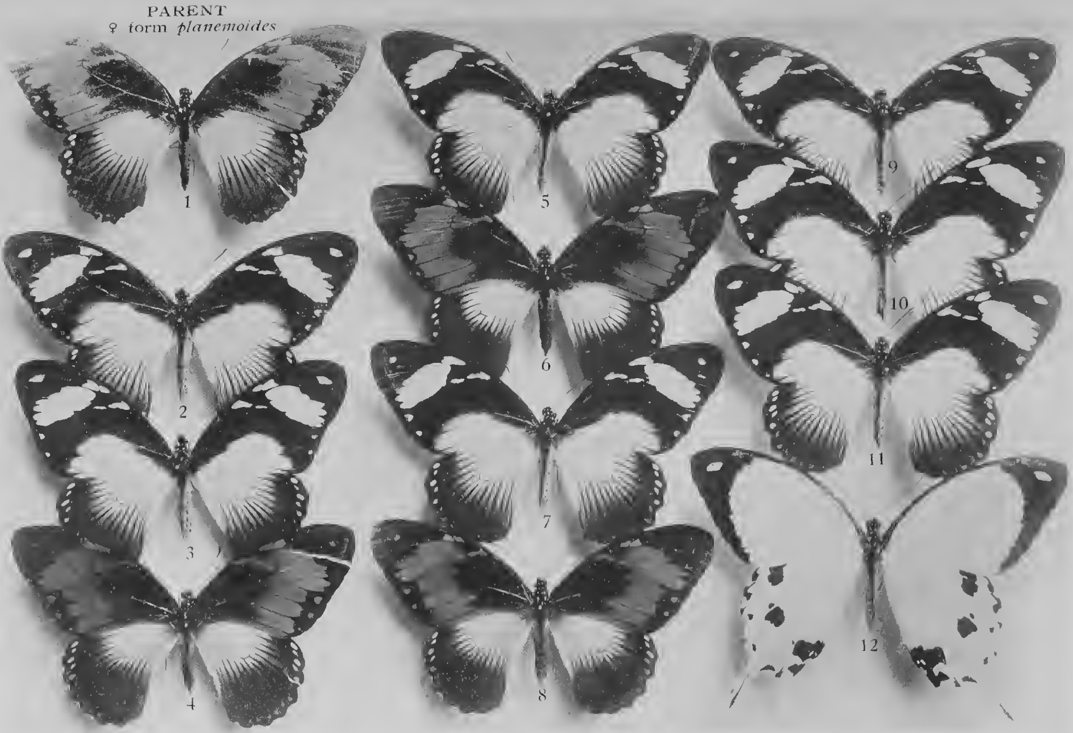
11. *Hippocoön*, emerged Jan. 28, before dawn; pupated Jan. 12.
12. Male, emerged Jan. 24, before dawn; pupated Jan. 8.



Alfred Robinson, photo. *Half the Natural Size.* *André & Sleigh, Ltd.*

Papilio dardanus Brown, male and two female forms. One ♂ (12) and all ♀ offspring—*hippocoon* (2, 3, 5, 7, 9, 10, 11) and 3 *planemoides* (4, 6, 8)—bred (1912-13) from a *planemoides* ♀ parent (1), on Bugalla I., Sesse Archipelago, N.W. Victoria Nyanza, by G. D. H. Carpenter.

EXPLANATION OF PLATE XL.

All figures are just over $\frac{1}{3}$ of the natural size.

Females of three families of *Papilio dardanus*, Brown, bred by W. A. Lamborn from female parents, also represented in the Plate, captured in the Lagos district of W. Africa, 1911 and 1912. Parents and offspring are all of the *hippocoön*, F., form.

The white mark in the cell of the fore-wing is clearly seen to be much shorter than the corresponding feature in the *hippocoön* offspring of a *planemoides* parent shown on Plate XXXIX.

Slight family differences between the white patterns are also represented in the Plate. Figs. 10, 12, 13, and 14 are examples of Family A in which the white area of the hind-wing is increased by a circumferential greyish extension, barely visible in figs. 9, 11, and 15. In Family D the same white area, as shown in figs. 17–21, and 30, is larger and more angular in shape than in Family E, as represented in figs. 32, 33, and 38—differences which appear in the respective parents—figs. 16 and 31, and are clearly hereditary. Family differences between the fore-wings are similarly evident when careful comparison is made (p. 659).

Figs. 1–15. Brood A (= Family I, W. A. L., described in Proc. Ent. Soc., 1912, pp. xii–xvii).

FIG. 1. Parent caught $1\frac{1}{2}$ m. E. of Oni, nr. Lagos, Oct. 19, 1911.
2. Offspring of 1. Emerged Nov. 30, 1911.
3. ,, ,, ,, Dec. 1, 1911.
4. ,, ,, ,, Dec. 2, 1911.
5. ,, ,, ,, Dec. 2, 1911.
6. ,, ,, ,, Dec. 2, 1911.
7. ,, ,, ,, Dec. 3, 1911.
8. ,, ,, ,, Dec. 3, 1911.
9. ,, ,, ,, Dec. 3, 1911.
10. ,, ,, ,, Dec. 6, 1911.
11. ,, ,, ,, Nov. 30, Shows faintest trace of "tail" on margin of hind-wing.
12. ,, ,, ,, Dec. 1, 1911. Shows faintest trace of "tail" on margin of hind-wing.

Explanation of Plate XL.

FIG. 13. Offspring of 1. Emerged Dec. 1, 1911. Shows more distinct trace of "tail" on margin of hind-wing.

14. ,, ,, ,, Dec. 2, 1911. Shows still more distinct trace of "tail" on margin of hind-wing.

15. ,, ,, ,, Dec. 2, 1911. Shows faint trace of "tail" on margin of hind-wing.

The degree of development of vestigial tail may be estimated by comparing figs. 11–15 with 9, 10, 30, and 38.

16–30. Brood D (= Family IV, W. A. L., described in Proc. Ent. Soc., 1912, pp. cxxxi–cxxxiv).

16. Parent, from same locality as 1, May 1, 1912.

The pupæ of this brood were exposed to temperature much reduced by ice, with a view to ascertaining if shock would cause more of the female imagines to revert to the ancestral tailed condition, than is the case with Family 1 (see specimens 11–15). Traces of tails can be seen in specimens 17–21, but no better marked than in 11–15 which were not treated with ice. It must, however, be remembered that four other families reared in a normal temperature by Mr. Lamborn (*loc. cit.* pp. xii–xvii, cxxxi–cxxxiv), showed no trace of "tails"; also that 17–20 exhibit a squarish outline rather more markedly than 11–15, an appearance due to the reduction of all undulations along the margin of the hind-wing except the one that represents the "tail."

17. Offspring of 16. Emerged June 6, 1912. Shows trace of "tail" at the angle of the squarish outline of hind-wing.

18. ,, ,, ,, June 7, 1912. Shows trace of "tail" at the angle of the squarish outline of hind-wing.

19. ,, ,, ,, June 7, 1912. Shows trace of "tail" at the angle of the squarish outline of hind-wing.

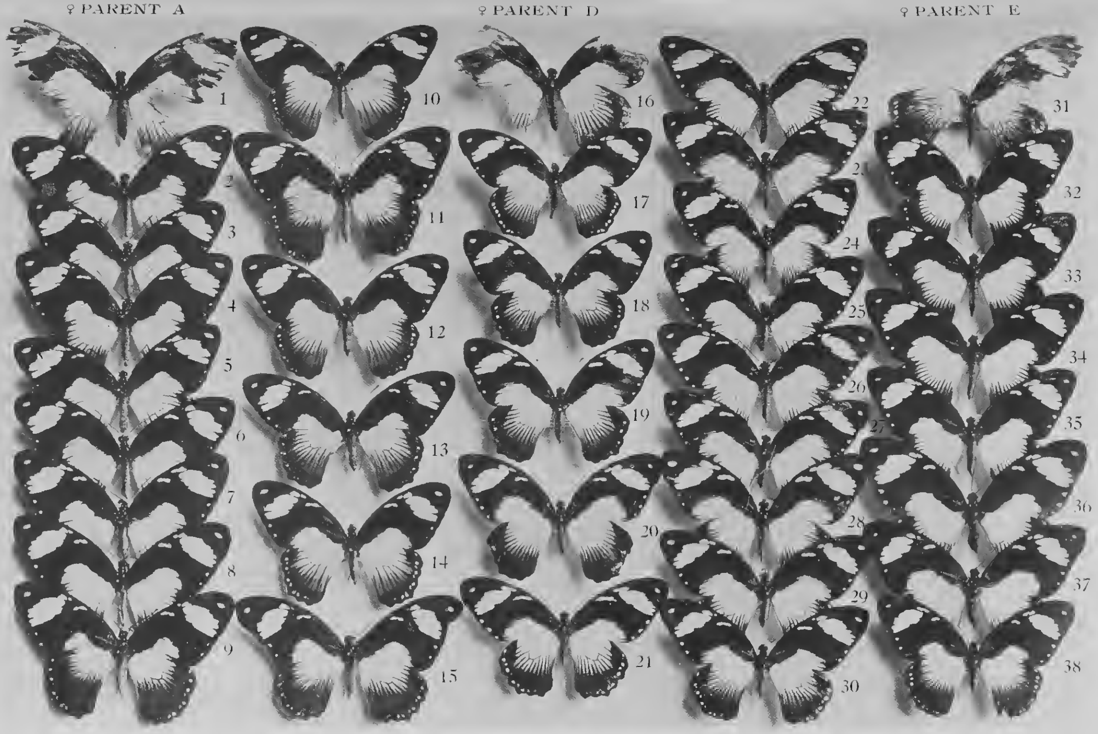
20. ,, ,, ,, June 7, 1912. Shows trace of "tail" at the angle of the squarish outline of hind-wing.

21. ,, ,, ,, June 7, 1912. Shows faint trace of "tail."

22. ,, ,, ,, June 5, 1912.

Explanation of Plate XL.

Fig. 23. Offspring of 16. Emerged June 6, 1912.
24. ,, ,, ,, June 6, 1912.
25. ,, ,, ,, June 6, 1912.
26. ,, ,, ,, June 7, 1912.
27. ,, ,, ,, June 7, 1912.
28. ,, ,, ,, June 7, 1912.
29. ,, ,, ,, June 9, 1912.
30. ,, ,, ,, June 7, 1912.
31–38. Brood E (= Family V, W. A. L., described in Proc. Ent. Soc., 1912, pp. cxxxi–cxxxiv).
31. Parent, in forest, Oni, nr. Lagos, June 18, 1912.
32. Offspring of 31. Emerged July 30, 1912.
33. ,, ,, ,, Aug. 1, 1912.
34. ,, ,, ,, Aug. 1, 1912.
35. ,, ,, ,, Aug. 1, 1912.
36. ,, ,, ,, Aug. 2, 1912.
37. ,, ,, ,, Aug. 2, 1912.
38. ,, ,, ,, Aug. 2, 1912.



Alfred Robinson, photo. *Just over $\frac{1}{3}$ of Natural Size.* *André & Sleigh, Ltd.*

Papilio dardanus, Brown, ♀ form *hippocoon*, F. All the ♀ offspring bred 1911-1912, from ♀ Parents A (1), D (16), and E (31), at Oni, 70 m. E. of Lagos, by W. A. Lamborn. Nos. 11-15 and 17-21 (pupae of Fam. D were artificially cooled) shew vestigial "tails" to hind wings. Slight differences as regards the white pattern may be recognised between the families.

9

II. Pseudacraea eurytus hobleyi, *its forms and its models on the islands of L. Victoria, and the bearing of the facts on the explanation of mimicry by Natural Selection.* By G. D. Hale Carpenter, M.B.E., D.M., F.L.S., F.E.S., F.Z.S., Uganda Medical Service.

[Read November 5th, 1919.]

Plates II, III.

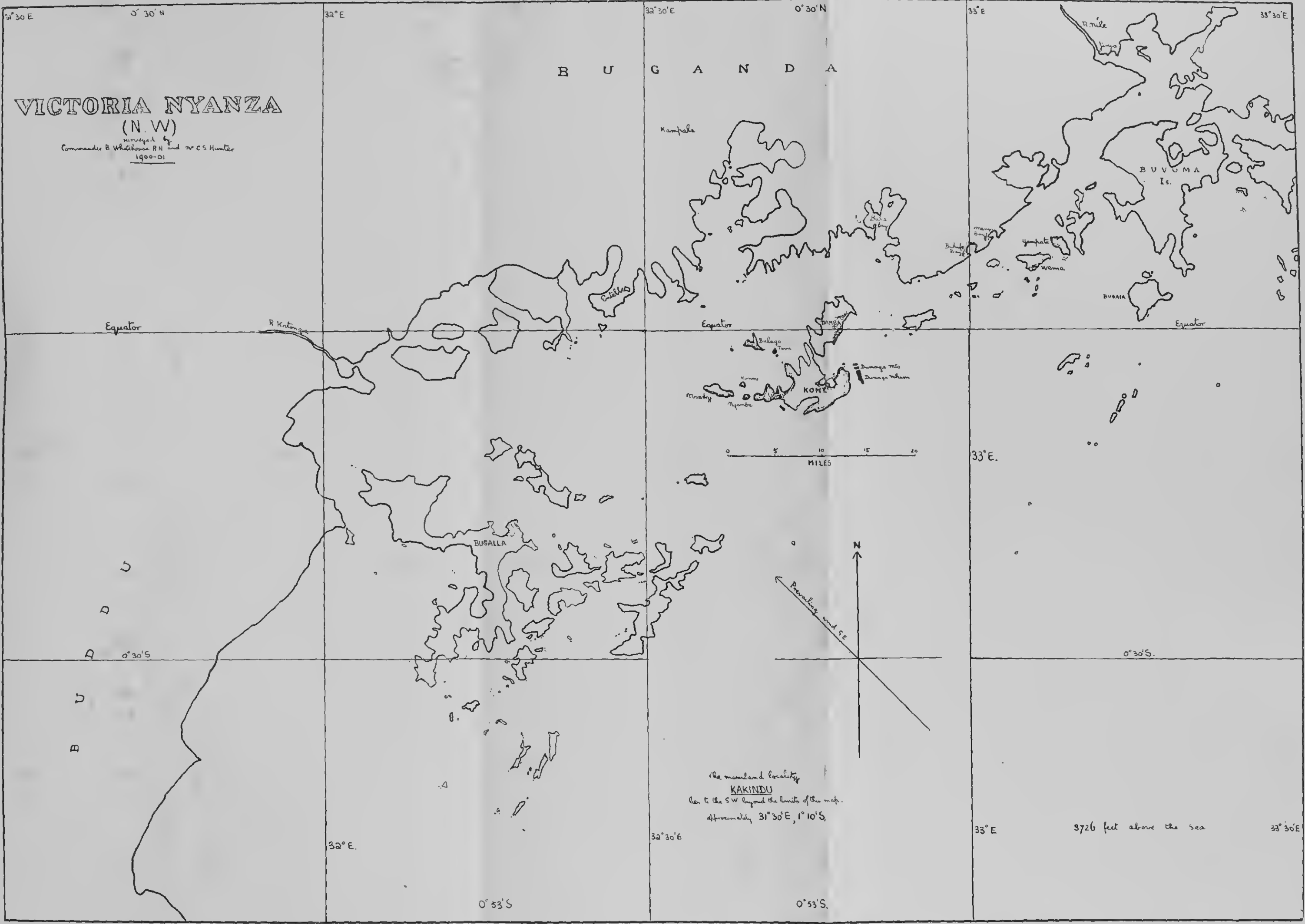
Forms of *Pseudacraea eurytus hobleyi* and its models were the subject of a paper which was communicated to the Society in November 1913, and was published in these Transactions, March 31, 1914, pp. 606–645.

The object of the paper was to show that with comparative scarcity of models on the islands, mimics which do not maintain the typically close resemblance are not destroyed by the action of natural selection (working, presumably, through vertebrate enemies), but are preserved; while in other places such as Entebbe on the mainland where models are more numerous than mimics the latter are kept true to type.

The explanation of the great number of varieties on the islands as compared with the mainland was first suggested to me by Prof. Poulton, as a result of a collection made on Damba island in 1911, which was described in Proc. Ent. Soc. 1911, pp. xci–xcv; 1912, pp. xxii–xxiii. Some of them were figured on Pl. xxxvi in the above-mentioned paper in 1914.

When I returned to the islands at the beginning of 1914 I went to a different group (see map), lying south of Entebbe and about twenty-five miles from it. Camp was pitched on the west end of the north shore of Kome, and the neighbouring small islands Bulago, Tavu, Ngamba, and Kimmi were frequently visited.

In August 1914 work was cut short by the call of active service, and during the rest of that year and in 1915 I was with troops on the Kagera river to the west of the lake. I spent many months at Kakindu (about 31° 30′ E., 1° 10′ S.), where was a fine forest known as the Tero forest, and here were obtained more specimens of the forms of *Pseudacraea eurytus* and their models.


VICTORIA NYANZA
(N. W)
surveyed by
Commander B Whitehouse RN and Mr C S Hunter
1900-01
31°30 E
0° 30' N
32° E
32° 30' E
0° 30' N
33° E
33° 30' E
B U G A N D A
Kampala
Entebbe
R. Nile
Jinja
BUVUMA Is.
Yempate
Wema
BUGAIA
Equator
R Katonga
DAMBA
Bulago
Kome
Dwanga Mto
Dwanga Mkuu
Nsadzi
Nyamba
KOME
0 5 10 15 20
MILES
33° E.
BUGALLA
N
Prevailing wind S.E.
B U D D U
0° 30' S
0° 30' S.
The mainland locality
KAKINDU
lies to the S W beyond the limits of the map.
approximately 31°30' E, 1° 10' S.
32° E.
32° 30' E
33° E
3726 feet above the sea
33° 30' E
0° 53' S
0° 53' S.

Lastly, after the signing of the armistice I was enabled to return to work on the islands, and went back to Kome in Dec. 1918, where I obtained more specimens from the same localities as in 1914, and also from the *eastern* end of the large island of Kome.

The specimens obtained from these localities have afforded most interesting and important data, exactly complementary to those in the earlier paper. The figures given in that paper may be here reproduced, together with the new data now discussed.

	Planema models.	*Pseudacraea* (all forms).
Mainland, 1909 (C. A. Wiggins, Entebbe)	252	88
Bugalla Island, 1912–13	129*	356
Kome and neighbouring islands, 1914 .	440	78
Mainland (Kakindu), 1915 . . .	102	13
Kome and neighbouring islands, 1918–19	39	55
Sundry other islands, 1918–19 . .	3	38

Study of the present data shows that :—

I. In 1914 on the islands *Planema* models were found to be very numerous and the *Pseudacraea* mimics less abundant and true to type, as in the Wiggins collection from the mainland.

II. On individual islands the predominant form of *Pseudacraea* was that which mimics the predominant *Planema* of that locality.

III. The collection from the Tero forest on the mainland (Kakindu) confirms the last result. In this locality the only abundant form of *Planema* was copied by the appropriate form of *Pseudacraea*, while only a single specimen of another form was taken.

IV. On the same islands in 1918–19, *Pseudacraea* was again more numerous, and more variable.

V. A collection from sundry other islands in 1918–19 contains ten times as many *Pseudacraea* as *Planema* models, nearly half of which are transitional.

The total numbers for 1914 are tabulated below for comparison with the Bugalla captures : the former are indicated by ordinary figures, the latter by Roman figures.

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* The total was wrongly added up to 127 in the description of the table in the 1914 paper.

Combination.	Models.	Forms of *Pseudacraea eurytus hobleyi* Neave.	Other mimics.
I A.	*Planema poggei nelsoni* Grose-Sm. ♂ II. 23 ♀ 0. 11	♀ forma mimetica *poggeoides* Poulton. II. 0	*Ps. kuenowi hypoxantha* Jord. ♂ III. 0 ♀ VI. 0 *Papilio dardanus* Brown. ♀ f. m. *planemoides* Trimen. I. 0
I B.	*Planema macarista* ♂ E. M. Sharpe. X. 70	♂ f. m. *hobleyi* Neave. XXVIII. 19	*Acraea alciope* Hew. ♀ f. m. *aurivillii* Staud. XI. 3 ♀ f. m. *alicia* Grose-Sm. approaching typical western form (I). 0 non-mimetic ♂ (V). 0 *Precis rauana* Grose-Sm. ♀ XXIII. 1 non-mimetic ♂ (XXIV). (5)
II.	*Planema macarista* ♀ VII. 18 *Planema alcinoe camerunica* Auriv. ♀ II. 33. not mimicked ♂ (VIII). (107) *Planema aganice* Hew. form *montana* Butl. ♀ 0. 49 not mimicked ♂ 0. (85)	♀ f. m. *tirikensis* Neave. XL. 17.	*Acraea jodutta* F. ♀ f. m. *jodutta* F. III. 2 non-mimetic ♂ (III). 4
		Forms transitional between ♂ *hobleyi*, ♀ *tirikensis*, and ♂ ♀ *obscura* Neave. ♂ XXIII. 0 ♀ XXII. 1	
III.	*Planema epaea paragea* Grose-Sm. ♂ XLI. 0 ♀ XXXIV. 0	f. m. *obscura* ♂ VII. 1 ♀ XIX. 3	*Papilio cynorta* Fabr. ♀ f. m. *peculiaris* Neave. ♂ 0. 0 Non-mimetic (I). 0
		Forms transitional between ♂ ♀ *obscura* and ♂ ♀ *terra* Neave. ♂ XXVI. 0 ♀ XI. 2	
IV.	*Planema tellus eumelis* Jord. (*platyxantha* Jord.) ♂ XXIV. 185 ♀ IX. 51	f. m. *terra*. ♂ LVI. 19 ♀ XLVIII 16	*Acraea jodutta* Fabr. ♀ f. m. *dorotheae* E. M. Sharpe. VI. 4
		Forms transitional between ♂ ♀ *terra* and ♂ *hobleyi* and ♀ *tirikensis*. ♂ XXXVI. 0 ♀ XXXVIII. 0	
Totals	CXXIX. 440	CCCLVI. 78	

The tables on pp. 88–90 give the numbers of the various species which are the subject of the paper, together with others belonging to the same combinations.

It is hardly necessary again to go through the four combinations of models and their mimics, as these were classified in the former paper.

Some points especially worthy of notice may, however, be mentioned.

Combination I.—The chief mimic in this group, *Pseudacraea kuenowi hypoxantha* Jord., was not very abundant on Bugalla island, neither is it at Entebbe. But it is quite absent from the collections which are the subject of this paper. The Papilionid mimic, form *planemoides* of *Papilio dardanus*, was only taken at Kakindu during the period under discussion, where it was the commonest form of female. This and other mimetic Papilios from Kakindu will, I hope, form the subject-matter of a future paper.

Combination I B.—The form *hobleyi* of *Ps. eurytus* shows considerable variation in the amount of white and orange on the hind-wing. The model, ♂ *Planema macarista*, usually has some orange bordering the white, and is often copied in this respect by specimens of *hobleyi*.

Acraea alciope is scarcer in these collections than in that from Bugalla.

Combination II.—A new member of this combination was found in abundance directly I arrived on Kome in 1914, namely *Planema aganice* Hew., form *montana* Butl. The male of this handsome species does not enter into any of the mimetic associations now under consideration, but its female is of the same type as that of *Planema macarista* E. M. Sharpe, and is figured with it. It is a very remarkable fact that, although so abundant on Kome in 1914, this species was never captured on Damba in 1911, where I spent nine months, and first made the acquaintance of the fascinating *Planema–Pseudacraea* combinations. Damba on its western side is only separated from Kome by a narrow channel of a few hundred yards! (see map). Equally interesting are the facts that it was never seen on Bugalla during fourteen months' residence in 1912–13, and only *one*, a male, appears in the large Wiggins collection made at Entebbe in 1909. But on looking through a collection that I made a little way east of Entebbe on the north shore of the lake in 1910 (Buka bay, see map), I found several examples of *Planema aganice montana*.

		Mainland (C. A. Wiggins) Entebbe, 1909.	Bugalla island, 1912–13.	Kome group of islands, 1914.					Mainland (Kakindu), 1915.	Kome island, 1918–19.	Sundry islands, 1918–19.
				Kome.	Bulago.	Ngamba.	Kimmi.	Tavu.			
Planema poggei nelsoni . .	♂	13	2	18	1	2	2		4	1	
,, ,, ,, . .	♀	1		7	1	1	1	1	6		2
,, *macarista* . . .	♂	84	10	31	7	20	12				
,, ,, . . .	♀	39	7	13	1	3	1				
,, *alcinoe camerunica* .	♀	11	2	23	2	3	2	3	4	2	
,, ,, ,, . .	♂	31	8	83	15	4	2	3	1	1	
,, *aganice montana* . .	♀			11	14	17	6	1	1	1	
,, ,, ,, . .	♂	1		24	20	23	17	1			1
,, *epaea paragea* . .	♂	12	41						10		
,, ,, ,, . .	♀		34						6		
,, *tellus eumelis* . .	♂	78	24	184	1				27	21	1
,, ,, ,, . .	♀	14	9	51					44		
Acraea alciope, form *aurivillii* .	♀	51	11	2		1			6		
,, ,, ,, *alicia* . .	♀	2	1								
,, ,, ,, ,, . .	♂	39	5						7		
,, *jodutta*, form *jodutta* .	♀	47	3	2					9		
,, ,, ,, *dorotheae* .	♀	23	6	2		1	1		8		

Acraea jodutta chrysippus-like .	♀	4		1		1					
,, ,, ,, . .	♂	63	3	4				1	40		
,, *althoffi*, form *althoffi* .	♀	3									
,, ,, ,, *telloides* .	♀	8									
,, ,, ,, ,, . .	♂	14							1		
Pseudacraea eurytus, form *poggeoides*	♀	1	2								1
,, ,, ,, *hobleyi* .	♂	36	28	8		9	2		1	8	3
,, ,, ,, *tirikensis*	♀	33	40	8		7	2			5	8
,, ,, ,, *obscura*	♂		7	1						1	2
,, ,, ,, ,,	♀		19	1		2					2
,, ,, ,, *terra* .	♂	6	56	19					5	11	1
,, ,, ,, ,, .	♀	10	48	16					7	8	7
,, ,, transitional .	♂	1	85							13	7
,, ,, ,, .	♀	1	71	3						9	7
,, *kuenowi* . . .	♂	1	3								
,, ,, . . .	♀	1	6								
Precis rauana	♀	?	23	1					6		3
,, ,, ...	♂	?	24	2	3				9		
Elymnias phegea (white marked) .	♀	1									
Papilio dardanus, form *planemoides*	♀	6	1						10		
,, ,, ,, *niobe* .	♀	2							2		

? = number not given.

Date.	Locality.	Acraeine (*Planema*) models.												Acraeine mimics.								Nymphaline mimics.									Papilionine mimics.				Satyrine mimic.		Hypsid moth mimic.
		I.				II.				III.		IV.		*Acraea alciope.*		*Acraea jodutta.*			*Acraea althoffi.*			*Pseudacraea.*							*Precis rauana.*		*Papilio dardanus merope.*		*Papilio cynorta.*		*Elymnias phegea.*		*Deilemera acraeina.*
		A. *poggei nelsoni.*		B. *macarista.*	*macarista.*	*alcinoe camerunica.*	not mimicked.	*aganice montana.*	not mimicked.	*epaea paragea.*		*tellus eumelis.*		*aurivillii* mimics I.	non-mimetic.	*jodutta* mimics II.	*dorotheae* mimics IV.	non-mimetic.	*althoffi* mimics II.	*telloides* mimics IV.	non-mimetic.	*eurytus hobleyi.* *poggeoides* mimics I. A.	*hobleyi* mimics I. B.	*tirikensis* mimics II.	*obscura* mimics III.	*terra* mimic IV.	*kuenowi.* mimic I.		mimics I.	non-mimetic.	*planemoides* mimics I.	*niobe* mimics IV.	*cynosta.*	*peculiaris* mimics III.	mimics I.	mimics II.	mimics II.
		♂	♀	♂	♀	♀	♂	♀	♂	♂	♀	♂	♀	♀	♂	♀	♀	♂	♀	♀	♂	♀	♂	♀	♂ ♀	♂ ♀	♂	♀	♀	♂	♀	♀	♀	♀			
1901	Damba Is.	2	1	1	1					4		7		+	+							1	5	4	3	15			+	+							
																						10 transitionals															
1912–1913	Bugalla Is.	2	0	10	7	2	8			41	34	24	9	11	5	3	6	3				2	28	40	26	104	3	6	23	24	1						
																						156 transitionals															
1914	Kome group of islands	23	11	70	18	33	107	49	85			185	51	3		2	4	5					19	17	4	35			1	5							
																						3 transitionals															
1918–1919	Kome Is.	1				2	1	1				21											8	5	1	19											
																						22 transitionals															
1918–1919	Sundry islands		2						1			1										1	3	8	4	8			3								
																						14 transitionals															
1909	Mainland (Entebbe) C. A. Wiggins	13	1	84	39	11	31		1	12		78	14	51	39	47	23	63	3	8	14	1	36	33		16	1	1	+	+	6	2		+		1	+
																						2 transitionals															
1915	Mainland (Kakindu)	4	6			4		1		10	6	27	44	6	7	9	8	40			1		1			12			6	9	10	2	+				+
																						0 transitionals															

Sign + indicates present, but numbers not given.

According to Eltringham's "African Mimetic Butterflies" the typical *aganice*, in which the male is paler and the female has the white areas of smaller extent, is "confined to the Natal region, and is represented in British and German East Africa by the variety *montana*, which has a much wider range, being common in the Belgian Congo."

An interesting point is that in 1914 when visiting a group of islands east of Kome (Wema, etc.) this *Planema* was not noticed there.

But in 1919 when revisiting all the islands I had been to in '14, I found *aganice* on the Wema group. I am quite inclined to think that it had arrived there since 1914.

The ♂ of *Planema alcinoe* sometimes shows strong suffusion of the brown near the base of the fore-wing by a dusky hue. If this were accentuated a distinct approach to the pattern of the ♂ *aganice montana* would be produced. This point requires further investigation.

A very interesting member of Combination II is the large black-and-white Hypsid moth *Deilemera acraeina* H. H. Druce. This occurs at Entebbe, but I had never found it until I collected at Kakindu, so that it does not seem to have made its way to the islands. It was noted in my journal that "I saw it on the wing and took it for another ♀ *Papilio cynorta* Fabr., but realised after a little that there was something different. Its flight was not like that of any Hypsid I have seen before; much more floating and like that of the *Papilio.*" *P. cynorta* ♀ is black and white, mimicking the ♀ *Planema epaea* of the west coast, which shows minor differences in its pattern from the *Planema* models of Combination II.

Another member of Group II, the black-and-white form of the Satyrine *Elymnias phegea*, which is not common at Entebbe, has never been met with on an island, nor at Kakindu.

Combination III.—The model, *Planema epaea* Grose-Sm., in its eastern form *paragea* was not taken on any of the islands discussed in this paper, although it occurs on Damba, which, as has been said, lies only a few hundred yards away from the eastern end of Kome. But several were taken at Kakindu, showing considerable variation. It is very interesting that at Kakindu *Papilio cynorta*, which was very abundant, was entirely of the *western* form, whose female mimics the black-and-white western form of *Planema epaea* which was not seen at Kakindu.

On the other hand, a few of the eastern form of the model, form *paragea*, *were* taken at Kakindu.

So here is an example of eastern (*Planema*) and western (*Papilio*) forms commingling on the western side of the great lake, while the form *peculiaris* Neave, of the *Papilio*, corresponding to the eastern model, did not occur.

Combination IV.—The form *dorotheae* of *Acraea jodutta* mimics *Planema tellus*, the model of this group. Another form is the black-and-white *jodutta*, belonging to Combination II.

A very interesting form has the subapical white bar on the fore-wing, but the other areas are of the rich orange of *dorotheae;* this corresponds to the more southern *esebria*, one of which was taken at Kakindu on 29.4.15. There is a very interesting similar variety of *Pseudacraea eurytus* transitional from *terra* to *hobleyi;* the likeness to the *Acraea* is remarkable, and the likeness of both to *Danais chrysippus*. A single ♂ of *Acraea esebria* was taken at Kakindu, of the same type as the last-mentioned form of *jodutta*. According to Eltringham this is "essentially a S. African insect" ("African Mimetic Butterflies," p. 81); it is considered by him to be distinct from *jodutta* although closely allied.

Acraea althoffi, of whose non-mimetic male a single one was taken at Kakindu, is of much interest since it has two forms of female which occur at Entebbe, but not in any locality where I have collected. These forms are secondary mimics in Combinations II and IV through the *jodutta* and *dorotheae* forms of *A. jodutta*, which are their primary models (Poulton, Report of 1er Congrès International d'Entomologie, 1911, pp. 504–506).

Transitional forms of Pseudacraea eurytus.—In the Bugalla collection of 1912–13 there were 85 ♂, 71 ♀ specimens showing a transition between the several named forms, out of a total of 356. In the collection from Kome, and the adjacent small islands lying off its western end, made in 1914, there were only 3 ♀ transitional forms out of a total of 77.

At Kakindu there were no transitional forms out of 13, which is not remarkable, seeing that all save one were of the form *terra*, corresponding to the predominant model. In 1918–19, however, on Kome island there were 22 transitionals out of a total of 52 *Pseudacraea*.

The proportions of *Pseudacraea* to *Planema* models in these localities are :—

	Wiggins coll. (mainland) 1909.	Bugalla (island) 1912–13.	Kome group (islands) 1914.	Kakindu (mainland) 1915.	Kome group (islands) 1918–19.	Sundry islands 1918–19.
Planema . .	252	129	440	102	39	3
Pseudacraea :						
(total) .	88	356	78	13	55	38
(transitionals)	2	156	3	0	22	14

CONCLUDING REMARKS.

These figures speak for themselves, and the specimens are in the Hope Department at the Oxford University Museum for any one to see.

It may be justly claimed that the results of recent collections are complementary to the former. That is, in the presence of greater numbers of models the mimics are found to be true to type, but when they outnumber the models many transitional and other varieties are found.

It was claimed in the previous paper that natural selection afforded the explanation, and this is further supported by specimens from Kome, Ngamba, and Kimmi islands and from Kakindu on the mainland (see map).

Locality.		Combination I.	Combination II.	Combination III.	Combination IV.
Kome, 1914	*Pl.*	56	47		235
	Ps.	8	8	2	35
Ngamba, 1914	*Pl.*	23	23		
	Ps.	9	7	2	
Kimmi, 1914	*Pl.*	15	9		
	Ps.	2	2		
Kakindu, 1915	*Pl.*	10	5	16	71
	Ps.	1			12

Kome is a large island and, like Bugalla, has forest along its shores and in patches on the high ground in its centre. Ngamba and Kimmi are quite small islands both covered almost entirely with forest. They are all so close together that it would be absurd to account for differences between the proportions of forms of *Pseudacraea* by climatic conditions. At Kakindu is a large area of forest at very little elevation above the lake level, extending from the lake shore five-and-twenty miles inland.

Now, on Kimmi the only *Planema* models in 1914 were the species with black-and-white females of Combination II, and the male of one of them belonging to Combination I. The only forms of *Pseudacraea* were *hobleyi* and *tirikensis* mimicking these combinations. On Kome the orange *tellus* of Combination IV predominated, and *terra* was the most abundant form of *Pseudacraea*.

On Ngamba, however, members of Combinations I and II were the prevailing models and the mimics were in proportions accordingly, to such an extent that just as *Planema tellus* appeared to be absent so was *terra* its mimic! But at Kakindu *tellus* was very much the most abundant, and all the *Pseudacraea* save one were of the corresponding form.

But the most remarkable feature of the collections now discussed is the difference between the proportions of models and mimics on Kome island in 1914 and 1918–19. On the former occasion 338 *Planema* models were taken, and only 56 *Pseudacraea*, of which only 3 were transitional: the proportion of model to mimic being 6 to 1. In 1918–19, however, 25 *Planema* models were taken but 55 *Pseudacraea*, of which 23 were transitional; the proportion of model to mimic being 1 to 2·2.

This most interesting result seems to fall in almost too well with the others! It is supposed that on an island such as Ngamba the insectivorous birds spare mimics in Combination II but destroy the rest, while on Kome and at Kakindu they find the model of Combination IV so much more abundant that its mimics are more often spared. This, of course, presupposes that the bird population of an island stays there, and that birds from Ngamba do not cross to Kome to hunt. Although this may seem an extravagant theory yet a tour among many islands in 1914 showed that the bird fauna of adjacent isles does differ, and I pointed out in 1918, in reply to some remarks by the late Colonel Manders on this very subject (Proc. Ent. Soc., p. xciii), that there is sufficient difference in tone between the songs of individuals of the same species on separate islands to show that some birds at least do not roam from one to another, otherwise such insular variations would not be perpetuated. I refer especially to flycatchers (*Platystira* and *Tchitrea*), but it must be admitted that the bee-eaters *Merops* and *Melittophagus*, in particular the former, cross over quite wide areas of water.

In the case of Kome, however, we find a gradual decline in the number of models and increase in mimics, with a great proportional increase in the number of transitional forms.

The destruction of butterflies, so far as selective action is concerned, is held to be mainly the work of young birds, which have to learn what to eat and what to avoid.

A young bird in 1914 would have found so many models that any member of a combination would have been more likely to be the relatively distasteful Acraeine; thus the youngster would learn to leave that combination alone, while *Pseudacraea* not conforming to the combination would have been destroyed. As this bird grew older, however, it would have found the models becoming scarcer and scarcer, and one must suppose that in consequence the bird forgot what these models tasted like, so that in later years no form of *Pseudacraea* had much more chance of surviving than any other; thus transitional forms would begin to be preserved.

A young bird hatched in 1916 would have come into a world where *Planema* and *Pseudacraea* were in approximately equal numbers, and thus its value as a selecting agent would have been very limited. For it was just as likely to meet a distasteful model or a relatively edible *Pseudacraea*, which might have been either a close mimic or a transitional form. But as soon as *Pseudacraea* became *more* abundant than *Planema* the absence of selection would come into play with ever-increasing force and transitional forms would become abundant, perhaps only limited by the range of variation and their physiological fitness.

As to the reasons for the decline in numbers of *Planema* on Kome from 1914 to 1918 I can give no satisfactory suggestion. When I first went to Kome it seemed to me that abundance of food-plant might account for the abundance of *Planema* there, as compared with Bugalla, where, for example, I never found the plant which I knew to be the food of *P. poggei*. But it is difficult to imagine that in four years the food-plants had *all* become scarce enough on Kome to cause so great a diminution in the numbers of *Planema*. It is more likely that parasitic enemies are the cause of waves of prosperity and decline as is known to be the case with so many species; an abundance of hosts one year produces an abundance of parasites which destroy so many hosts that they in turn diminish in numbers, after which the host again increases.

In conclusion I should like to express my great regret that the late Colonel Manders, who so strongly criticised my first paper, is no longer here to see the results of further investigation of these interesting *Pseudacraea*. One feels that his doubts as to the correctness of the explanation of mimicry by natural selection would have been still further shaken by the new facts brought forward in this paper.

I am indebted to my kind friend and mentor Prof. Poulton for much helpful advice in the preparation of the paper: the arrangement of the specimens for reproduction is due to him and Dr. S. A. Neave, to whom I am much indebted.

EXPLANATION OF PLATE II.

Model species of *Planema* on the left; mimetic forms of *Pseudacraea eurytus* on the right, each opposite to its model. All figures are $\frac{3}{5}$ natural size.

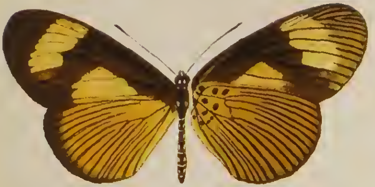
FIG. 1. *P. tellus*, ♀. Kome Isle. 12.viii.1914. Caught by "boy" at edge of forest.
2. *Ps. eurytus* f. *terra*, ♀. Damba Isle. 1–15.ix.1911. In jungle, east side.
3. *P. epaea paragea*, ♀. Bugalla Isle. 24.ii.1912.
4. *Ps. eurytus* f. *obscura*, ♀. Bugalla Isle. 18.ii.1912.
5. *P. macarista*, ♂. Entebbe. 15.viii.1910. Caught by one of Dr. Wiggins' "boys."
6. *Ps. eurytus* f. *hobleyi*, ♂. Wema Isle. 1.iii.1918. In jungle on south shore.
7. *P. macarista*, ♀. Kome Isle. 29.vi.1914. Edge of forest.

Westwood Bequest

Trans. Ent. Soc. Lond., 1920. Pl. II.

Acraeine models

Nymphaline mimics.



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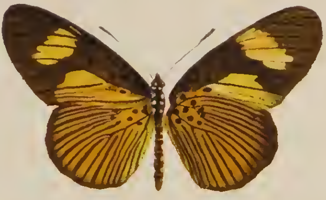

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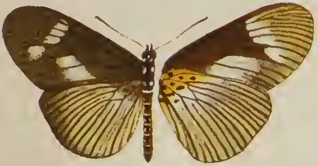

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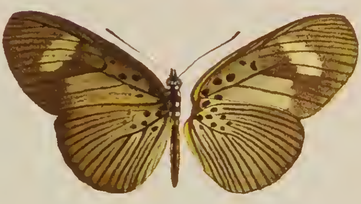

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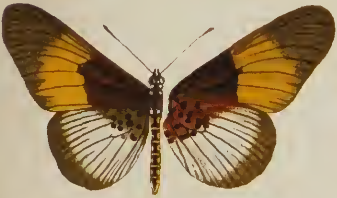

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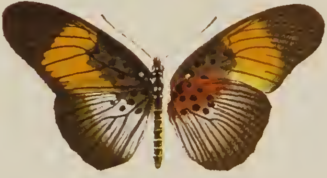

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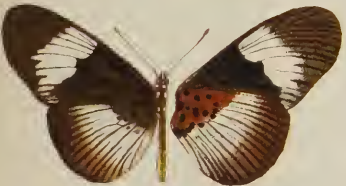

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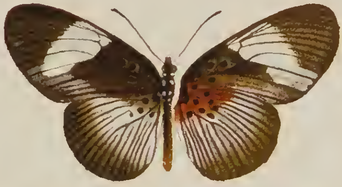

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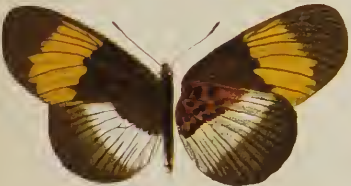

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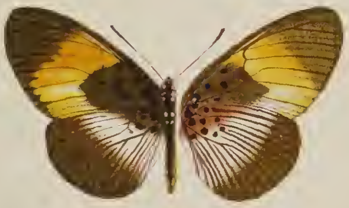


10.

E.C. Knight del. et chromo

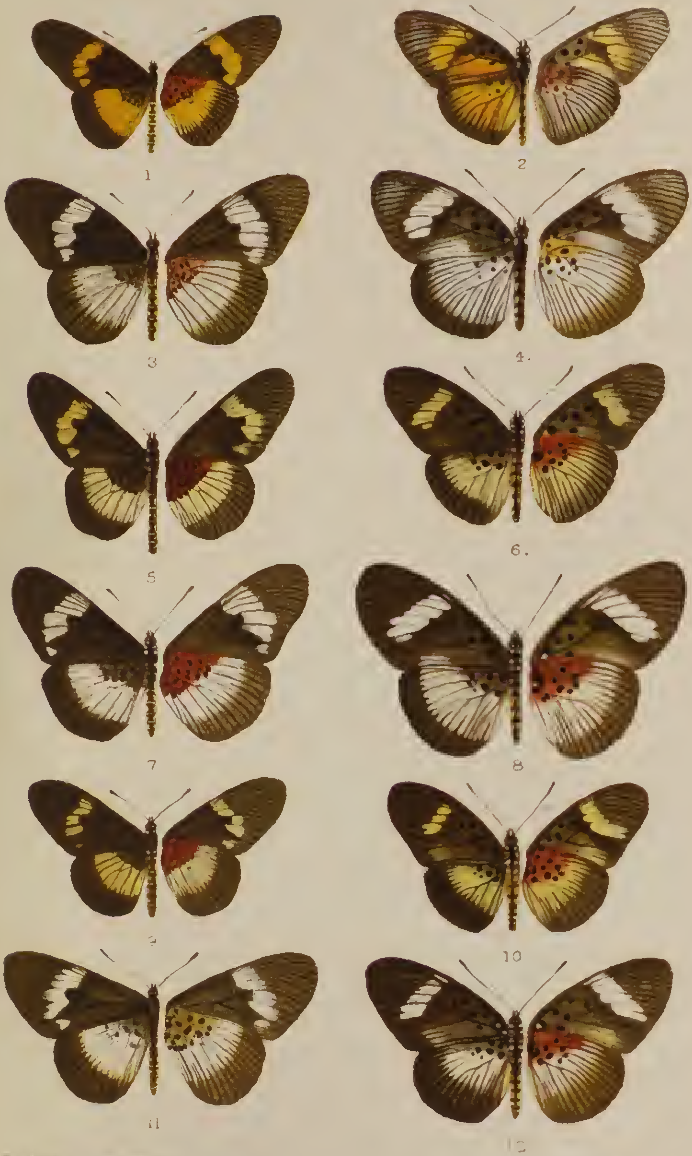
Huth imp.

MODEL SPECIES OF *PLANEMA* WITH MIMETIC FORMS OF *PSEUDACRAEA EURYTUS*.

¾ nat. size.

Westwood Bequest. Trans. Ent. Soc. Lond. 1920. Pl. III

Acraeine models. *Nymphaline mimics.*



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MODEL SPECIES OF *PLANEMA* WITH MIMETIC FORMS OF *PSEUDACRAEA EURYTUS.*

[illegible]

8. *Ps. eurytus* f. *tirikensis*, ♀. Bugalla Isle. 6.xii.1912. Edge of forest.
9. *P. poggei*, ♀. Bulago Isle. 15.iii.1914. Flying across open grass land.
10. *Ps. eurytus* f. *poggeoides*, ♀. 13.viii.1911. S. A. Neave, near west foot of Mt. Elgon, in strip of forest, height 3600 ft. above sea.

The specimens are arranged in geographical order from Uganda eastwards to Mombasa (Plate III) and then southwards.

EXPLANATION OF PLATE III.

Model species of *Planema* on left; mimetic forms of *Ps. eurytus* on right, each opposite to its model. All figures are $\frac{2}{3}$ natural size.

FIG. 1. *P. aganice* f. *montana*, ♂. 11.vii.1914. Ngamba Isle, forest edge.
2. *Ps. eurytus* f. *rogersi*, ♂ (the type). November 1906. Caught by Rev. K. St. A. Rogers, Shimba, about 16 miles west of Mombasa, about 1200 feet.
3. *P. aganice* f. *montana*, ♀. 1.viii.1914. Tavu Isle, forest edge.
4. *Ps. eurytus* f. *rogersi*, ♀ (the type). 28.vii.1906. Rabai, about 14 miles N.W. of Mombasa.
5. *P. aganice* f. *nyasae* n. ♂. 13.vi.1913. S. A. Neave. Mt. Mlanje, Nyasaland, 3000 ft.
6. *Ps. eurytus* f. *mlanjensis* n. ♂. 11.xii.1913. S. A. Neave. Mt. Mlanje, Nyasaland, 3000 ft.
7. *P. aganice* f. *nyasae* n. ♀. 10.vi.1913. S. A. Neave. Mt. Mlanje, Nyasaland, 3000 ft.
8. *Ps. eurytus* f. *mlanjensis* n. ♀. 17.iii.1913. S. A. Neave. Mt. Mlanje, Nyasaland, 3000 ft.
9. *P. aganice*, ♂. 13.iv.1897. G. A. K. Marshall. Malvern, Natal, 700–800 ft.
10. *Ps. eurytus* f. *imitator*, ♂. 7.v.1910. Bred by the late A. D. Millar in the Durban district, Natal.
11. *P. aganice*, ♀. 22.iii.1896. G. A. K. Marshall. Malvern, Natal, 700–800 ft.
12. *Ps. eurytus* f. *imitator*, ♀. 20.iv.1910. Bred by the late A. D. Millar in the Durban district, Natal.

The specimens from Mt. Mlanje, Nyasaland, are of great interest as showing a local variety of the *Planema* with the pale areas on fore- and hind-wings larger than in the typical S. African form; this variety is faithfully copied by the local race of *Pseudacraea* which shows a beautiful transition between the typical Southern form *imitator* and the northern and most eastern of the forms of *eurytus*, namely *rogersi*, and also the Uganda and west-coast form *tirikensis*. In the female the white subapical patch on the fore-wing, larger than in typical *imitator*, is very like that in some of the specimens of *tirikensis* most resembling their model (*macarista*, ♀), in which the posterior end of the white fore-wing bar is suppressed (cf. fig. 7 and 8, Plate II). On the hind-wing the Mlanje females have a much larger white area than do the typical Natal *imitator*, in this resembling the female *rogersi*. On the under surface of the hind-wing the Mlanje specimens, both ♂ and ♀, show a basal red patch which in shape and tint is transitional between the narrow but long purplish red patch of Natal *imitator* and the more triangular umber patch of *tirikensis*.

The general appearance of these forms is sufficiently indicated by the plates. I propose the name *nyasae* for the Mlanje race of *Planema aganice*, and *mlanjensis* for the corresponding form of *Pseudacraea eurytus*.

LINNEAN SOCIETY OF LONDON.

Extract from Report of the General Meeting, 7th March, 1918.

p. 10.

Lord ROTHSCHILD, F.R.S., F.L.S., exhibited a large series of "Mimetic Species of the African Nymphaline genus *Pseudacræa* and the Lycænid genus *Mimacræa*, together with their Acræine and Danaine models and some co-mimics," and read the following summary:—

The exhibition is intended to illustrate not only the strong mimetic tendency in the genera *Pseudacræa* and *Mimacræa*, but also to show that the various cases of mimicry appear to centre round a few given models and is evident in a number of genera not at all related or closely connected. This goes to prove that the variation in a given direction is due to local external conditions and has become fixed by selection and the influence of the Mendelian law. The curious case of *Acræa encedon*, a non-edible species, also mimicking the Danaine model *Danais chrysippus*, goes far to prove this, for the resemblance of two protected insects of different sub-families can only be considered as resemblance or rather similarity produced by one and the same external influence. The exhibit was primarily got together as a supplement to Professor Poulton's wonderful case of the *Pseudacræa poggei* and its new form *carpenteri*. I also exhibit the NON-MIMETIC males of the *Papilio* co-mimics as well as the NON-MIMETIC species of *Pseudacræa*. Special attention is drawn to the unique specimen of the red form of *Pseudacræa imitator*, the *chrysippus* like *Pentila*, and the *dorippus* forms of *Telipna* and *Pseudalitis*.

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p. 10.

Prof. E. B. POULTON, F.R.S., F.Z.S., showed specimens of a new Mimetic form of *Pseudacræa poggei* (Dewitz) from ex-German East Africa, with other African mimics of *Danaida chrysippus* (Linn.).

He also gave an account, illustrated by a large selection of lantern-slides, of "The Mimetic and Mendelian Relationships of the 'White Admirals' of North America," of which the following is an abstract:—

The "White Admiral" butterflies of the Nymphaline genus *Limenitis* or *Basilarchia* (the North American sub-genus) form an interesting group with peculiar larvæ and pupæ. Their conspicuous patterns are displayed in a floating flight and the under surface of the wings is not procryptically coloured like that of the Vanessas—characteristics which are found in the specially protected models for mimicry, and the Müllerian mimics of other still more distasteful species. And so it is with *Limenitis.* The English *L. sibylla* is resembled by the female of the "Purple Emperor" (*Apatura iris*) which flies in the same woods, while the tropical American representatives of *Limenitis*—the powerful genus *Adelpha*—are beautifully mimicked by the females of the representatives of *Apatura*—the genus *Chlorippe.* The African representatives of *Limenitis*—the genus *Pseudacræa*—are almost all of them wonderful mimics of the Acræas and in one instance of a Danaine.

The North American species form a singularly interesting group divided until recently into six species. Of these, two, *weidermeyeri* and *arthemis*, are black-and-white butterflies somewhat resembling *sibylla*; one, *lorquini*, appears to be a similar butterfly, modified by mimicry of an *Adelpha* or allied form which meets it on the west of the continent; two, *archippus* and *obsoleta* (*hulsti*), are beautiful mimics respectively of *Danaida* (*Anosia*) *plexippus* and *D. strigosa*, both ancient Danaine invaders from the Old World into the New; finally one, *astyanax*, is a mimic of *Papilio philenor* or more probably of *Papilio* co-mimics of the same model. *Astyanax* is also, according to Scudder, the model for the female of *Argynnis diana.*

The black-and-white *arthemis* of the north and the southern dark *astyanax* meet and overlap in a narrow zone where an intermediate form *proserpina* is also found, considered by Scudder as a hybrid between the two. The recent successful breeding experiments of W. L. W. Field leave no doubt that *proserpina* is certainly a heterozygote which splits up into the two parent strains in the F_1 generation. In the light of this important result *astyanax* becomes the southern race and *arthemis* the northern of a single species, but the rarity of *proserpina* seems to prove the reality of sexual preference within each race in the zone of overlap.

Lord ROTHSCHILD, Mr. W. BATESON, Dr. G. B. LONGSTAFF, Mr. HAMILTON H. C. J. DRUCE, and Sir HENRY HOWORTH, F.R.S. (visitor), engaged in a discussion, the Author replying.

Mr. HAMILTON DRUCE exhibited several species of *Mimacræa* from his collection, amongst them *M. Landbecki*, *M. Eltringhami*, *M. Krausei*, and *M. skoptoles.*

12

Section D.—Birmingham, 1913.] [BRITISH ASSOCIATION.
Report, p. 516.

The Enemies of 'Protected' Insects; with special reference to Acræa zetes. *By* Dr. G. D. H. CARPENTER.

Supporters of the theory of mimicry believe that certain insects escape being eaten by vertebrates generally on account of distastefulness, the possession of a sting, spines, &c. Such are said to be protected insects. This is not meant to imply protection against *every* enemy, or even against every vertebrate enemy. Such a state of affairs would soon bring itself to an end by the unlimited increase of such an insect. There is evidence that bee-eaters, for instance, prey especially upon such a typically protected insect as the honey-bee; that cuckoos prey especially upon hairy caterpillars shunned by other birds. But the enemies of protected insects that are of much importance are predaceous insects and parasites. I have seen in Uganda insects belonging to typically protected groups (Hymenoptera, Hemiptera, &c.) being preyed upon by predaceous insects.

Since of all the offspring on the average only two individuals will survive to carry on the race, insects which escape vertebrate enemies must be all the more destroyed by parasitic or predaceous insects. In the case of *Acræa zetes*—a typically 'protected' butterfly—out of seventy full-fed larvæ and pupæ obtained in Uganda, only sixteen, or 23 per cent., became butterflies, 77 per cent. being destroyed by parasitic insects. Since all these had been collected when full-grown (*i.e.* they had escaped the dangers of infancy), the destruction at all stages, including ova, is probably greater. So that less than 23 per cent. is all that is left for destruction by both predaceous insects and vertebrates.

The matter may be expressed as a formula. If X is the total number of offspring, then $X-2=$ number destroyed by all influences. Putting P for those destroyed by predaceous insects, p for those succumbing to parasites, and V for those destroyed by vertebrates, then

$$V=(x-2)-(P+p)$$

V may thus be taken to indicate the degree of edibility to vertebrates, since the number destroyed by parasites, &c., must bear an inverse relation to the number destroyed by vertebrates. Could P (destruction by predaceous insects) be accurately estimated, a figure could be given for V, which might be called the edibility index; it would probably be found to be high for unprotected insects and the reverse for protected insects.

On the other hand an eminently edible insect may escape vertebrate foes through the perfection of its procryptic resemblance to its surroundings, or, according to the Batesian theory, of its mimetic resemblance. In this case V would be low, not because the insect was distasteful, but because it escaped attack; so that in the case of an insect known to be edible, V would be the index, not of edibility, but of success in disguise. Such insects would also be highly parasitised. In the case of the larvæ of the mother-of-pearl moth I believe V to represent the index of agility in escaping vertebrates. The larva is highly edible. Some years ago I collected large numbers as food for green lizards, which eagerly devoured them. But I found a very large proportion indeed were parasitised. The larva lives in a tube of nettle-leaf and is extremely adroit at escaping through one end of the tube directly the other end is investigated, and it seems likely that it must escape birds in this way.

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TRANSACTIONS
OF THE
ENTOMOLOGICAL SOCIETY
OF
LONDON
FOR THE YEAR 1921.

I. *Experiments on the Relative Edibility of Insects, with special reference to their Coloration.* By G. D. HALE CARPENTER, D.M., B.Ch. (Oxon.), F.L.S., F.E.S., F.Z.S., Uganda Medical Service.

[Read June 2nd, 1920.]

[*Note.*—In the absence of Dr. Carpenter in Uganda I have corrected the proofs of his paper and compared all the species Nos. with the material in the Hope Department. In this work much kind assistance was given by Canon K. St. Aubyn Rogers. A few additional determinations in the Acridiidae, due to the kind help of Dr. B. P. Uvarov, have been inserted. One or two notes, signed by my initials, have been added, together with a few references to the literature of the subject. In order to avoid overburdening the paper I have chiefly made use of "Essays on Evolution" (Oxford), which contains full references up to 1908, the year of publication.—E. B. POULTON.]

FOREWORD.

OWING to the great increase in the cost of printing, this paper as originally written has had to be cut down very greatly.

The first 99 observations are given seriatim as originally written, but afterwards only those are included which show some point of especial interest. Three series of tables have been entirely omitted—two designed to show at a glance how colour and edibility are correlated, and one giving a comparison between the two monkeys. But the complete original manuscript, together with the specimens used, may be seen in the Hope Department, Oxford University Museum.

July, 1920.

Preliminary.

The following experiments, whose object is to test the edibility of procryptic * insects and the relative inedibility of aposematic insects, a young monkey being used as judge, were performed while I was on active service in ex-G.E.A. in medical charge of two small posts near Tabora between Dec. 28, 1916 and Feb. 6, 1917. There was very little work to do, and I was often hard put to it to occupy myself until I discovered that there was a young monkey in the camp. This was a splendid opportunity, and I at once borrowed him and set to work. The monkey was a delightful youngster of the abundant grey species of *Cercopithecus*, with a whitish band over the eyes; he had been obtained when very young, and consequently was perfectly tame and used to being handled, indeed, so accustomed was he to human society, that he was unhappy when alone. For the purposes of the experiments it was necessary to keep him tied up, but previously he had been allowed to run where he pleased.

The Margin of Error.

Experiments upon the edibility of insects to a monkey need to be very carefully and systematically conducted, with full recognition of the very wide margin for error. It is quite useless to offer an insect to an unknown captive monkey in an unknown state of hunger or repletion, and to draw conclusions from that. In the first place, a knowledge of the monkey's individual temperament and habits is essential, in order that one may interpret correctly its behaviour when an insect is offered. The monkey must be so accustomed to the observer that his presence has no disturbing effect; but, on the other hand, one has to remember that after a while the monkey recognises that one is bringing him tasty morsels to eat, and is apt to become very excited, snatch at the insect, and put it into his mouth without having adequately seen it. If he is then very hungry, a hasty observer might conclude that the insect is very edible, whereas under other conditions the monkey might have ignored it.

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* The terms Procryptic and Aposematic, first used by Prof. E. B. Poulton, F.R.S., in his book, "The Colours of Animals," Lond., 1890, imply respectively a protective resemblance to surroundings, and conspicuous "warning" colours.

It is, of course, very advisable to offer the same species repeatedly; but, as a matter of fact, an insect that has been found to be eaten readily, always will be so eaten as long as the monkey will eat anything. Although, as regards the mere fact that they are *eaten*, there is no difference on paper between a relatively distasteful insect eaten under stress of hunger, and an edible insect eaten by a monkey not very hungry, yet to an observer the difference is very marked. The former insect will be taken in hand, looked at, tasted, pulled about, and perhaps eaten piecemeal, with a doubtful expression; whereas the latter will be at once eaten with every indication of pleasure. I may say that the monkey's *facial expression* gives a very accurate indication of whether or not the insect is tasty.

Once I offered the monkey my closed hand. He came up to see what was inside, and I opened my hand and showed him a beetle which previous experiment had proved to be very distasteful. The monkey literally broke into a broad grin and walked away, evidently taking it as a joke!

Another matter of importance is the choice of a time for the experiment when nothing else is likely to distract the monkey's attention, and there should be no one present but the observer. If an insect is offered, and the monkey's attention is suddenly directed to something else, he is very apt to put quickly into his mouth and bite up a species which he did *not* want for food. Again, sometimes when an insect had been offered which the monkey took and dropped, if one made a movement to recover it, for record, the monkey would often, out of sheer mischief, take it and crunch it up, although he had just refused to eat it! Here again a hasty or inexperienced observer might be misled.

Method of Experiment Adopted.

The monkey was kept tied up to a pole, with a shelter-box and perch half-way up it. The ground immediately around the base of the pole was cleared of vegetation, so that one could put down insects for the monkey (hereafter alluded to as M.) to see as they ran about.

After the first few occasions the method which yielded the best results was soon found. If one wanted to test the *degree of inedibility* of an insect previously shown to be more or less distasteful, it was offered either before the monkey had had any food at all, or after some vegetable food but before any other insects. Refusal under such circumstances implies a high degree of inedibility.

Having started the experiment with such insects, one next proceeded to "take the edge off" the monkey's appetite before offering other insects whose edibility was to be ascertained. *This I look upon as most important*, and I never undertook any experiment, after the first, without having at hand a large number of some insect which I knew M. would always eat greedily. I found Acridiids most useful for this, as numbers of one or other common species can usually be obtained. These will be alluded to as "*Staple food*" or "*Staple Acridians*."

It was also equally important to have some available at the *end* of the experiment, so that one could prove that M.'s refusal of some insect was not due to repletion. It will be seen later what a surprising amount M. could eat.

The preliminary feeding accomplished, species were then offered the edibility of which one desired to test, and the manner in which M. dealt with each was at once carefully noted in an abbreviated form, before the next species was offered. This I look upon as essential, for if one has a long series to test, one's memory soon becomes confused. These short notes were copied out and elaborated as soon as possible afterwards, while the memory was still fresh.

As regards the typically *Procryptic* insects, it does not much matter in what part of the experiment they are offered, since they are always eagerly eaten. An *Aposematic* species, or one whose edibility is doubtful, is best offered for the first time in the middle of an experiment, and for the second time nearer the beginning or at the very commencement.

Finally, staple food is again given and the inedibility of insects previously refused is judged to be the greater the more staple food is eaten at the end!

Precautions should be taken that M. does not suffer from *thirst*, otherwise errors will be made, for he may then refuse insects which, when not thirsty, he might have eaten. The monkey was, of course, not allowed to snatch an insect from my hand without having adequately seen it. It was brought in such a way that he could see it well before it came within reach :—often insects were put on the ground out of his reach and allowed (or forced) to crawl gradually towards him. In the case of a *butterfly*, it was found a good plan to cut off the two wings of one side, so that it could be allowed to flutter about on the ground; moreover, the amputated wings could be kept for record : in the case of very active winged insects it was sometimes necessary to quiet them a little with a short period in a cyanide-bottle. Wherever possible the actual specimen that was refused was kept for record. In the case of edible species the ideal was to find a pair in copulâ of which one could be given and the other kept. A second individual could usually be found, but in a few cases, unfortunately, there is no specimen for record.

All insects experimented with were "hand-picked," that is to say I went to look for them and did not collect by beating bushes or sweeping beds of herbs. So that every insect was seen in the surroundings it had chosen for itself, and thus only can one judge with confidence whether a species is aposematic or procryptic.

A very much more interesting method is to take the monkey out hunting on a lead. The monkey, of course, must be very tame, otherwise he is either anxious to escape or else frightened at being taken away from his home. In the place where I first commenced these observations there was an excellent piece of ground, flat, with grass kept short by cattle-grazing, and low bushes dotted about. M. could see his home from there, and though on the first few occasions he was a little frightened of going away from me for more than a few feet, he soon became quite at home. I used to take him out on a long lead, note-book in hand, and note down exactly what he did, what he ate, and what he did not eat. It was necessary to keep him on the rope, as otherwise he would rush about much too quickly and get out of reach. Under these almost natural conditions one got most interesting results, and saw how M. avoided insects that had the appearance of inedibility, and how remarkably quick he was in discovering the edible species. Indeed, his acuity of vision frequently was surprising. He would often leap down from my arms and take one of his favourite Acridians, which I had quite failed to see, on the stem of a bush a yard or two away. I used to take him to a bush and try to see for myself what was on it, and it was remarkable how I failed to see the fine large Mantid (No. 19) which in form and colour is typically procryptic. This was a very favourite food of the monkey, and I was able to see the very remarkable *defensive attitude* of the Mantid, which could never have been seen had it been taken away from its surroundings and offered to the monkey.

Not only did nothing down below escape M.'s quick eyes, but even when fully occupied with insects he always "kept one eye lifting" for danger from above, and my attention was several times drawn by his quick, nervous glances upwards, to some soaring bird which might be a bird of prey. Thus I feel quite certain that conspicuous insects to which he paid no attention when out hunting were not unseen, but purposely ignored.

Interpretation of Monkey's Behaviour.

As regards interpretation of M.'s behaviour, I soon learnt, from his expression and treatment of an insect, in what category to place it. A very curious method was to paw it violently on the ground with swift repeated strokes of one hand after another. This may be perhaps called a method of attack against insects not necessarily inedible, but whose bite or sting is especially to be feared. No doubt it so confuses them that they may be rapidly picked up and eaten. But this treatment is also directed against species that are particularly distasteful, and indicates profound dislike, quite apart from fear of sting or bite, for I have seen M. violently rub his hands on the ground without once touching the object of his dislike, which was allowed to escape unharmed! Sometimes after pulling a distasteful insect to pieces M. would rub his hands on the ground in the same way, obviously for the sake of cleaning them; it was probably association of ideas which led him to rub his hands on the ground without touching the insect, as just described above.

The most edible insects were at once taken and eaten without a moment's hesitation. Sometimes a species which had not been seen before would be looked at attentively and then eaten with gusto. The next step down the scale is afforded by species at which M. looked, then bit off the head or head and thorax, and finding this edible ate the remainder without hesitation. Below this are placed insects that were smelt, licked, and tasted, then perhaps pulled to pieces by teeth and fingers and often only partially eaten; or after preliminary tasting such an insect might be put into the mouth whole, only to be pulled out again with an expression of dislike, or surprise, and be re-examined and pulled about. A sure sign of dislike on M.'s part was to run off with an insect to his perch and examine it there, instead of at once dealing with it. After these somewhat distasteful species may be classed those which, after a preliminary smelling and licking, are discarded (often thrown down with a very decisive manner, as if to say "that's enough of *you*"), or allowed to escape; and, finally, those which are not even tasted, but left severely alone, or perhaps merely touched, or turned over by a paw.

Record of Observations.

I will now proceed with the observations, copied, with certain omissions after *Obs.* 99 (p. 23), from my journal. Each species and each observation bears a serial number. All observations of one series (*i. e.* made on one occasion) are embraced under a serial letter. This is Section I of the paper. I then propose to take the species by families and genera, and put together all the notes on one species (including the omissions) so as to arrive at conclusions as to their degree of edibility; this will be Section II. The same method is followed with a second monkey, Section III giving observations, and Section IV the estimated edibility of species arranged by families. Finally, the pith of the results is expressed in charts and diagrams, and some general remarks on cases of mimicry, etc., are made. It is much to be regretted that owing to scarcity of Lepidoptera I was unable to put mimicry to the test in this group, but with some other insects it appeared to be of real value.

SECTION I.

Series A.—This first series was made on Dec. 28, 1916, when I first saw the monkey. His master being away, he had been left in charge of a boy, and had been tied up for several days, almost certainly without any insect food, for which he was *very eager*.

Observation 1. *Species* 1.—A Cassidid beetle, *Cassida* sp.: typically aposematic, found freely exposed on low herbage, bright orange with bold black spots. M. made eager preparations for taking it from off my finger, but as it got nearer it could be more clearly seen, and M. did not snatch at it, but took it carefully, examined it, put it into his mouth without any appearance of eagerness, crunched it slowly and rather doubtfully, eventually either swallowing it or putting it in his cheek-pouch. I gave him another and he examined it and pulled it to pieces, smelt it, and slowly ate it without enthusiasm.

Obs. 2. *Sp.* 2.—Clytrid beetle, *Clytra wahlbergi* Lac.: fairly large, black and scarlet, sits freely exposed on low herbage, typically aposematic, offered to M. on a finger; he examined it and crunched it up without any enthusiasm, and brought it up again into his mouth to be again masticated as if very doubtfully worth eating.

Obs. 3. *Sp.* 3.—Phytophagous beetle, *Physodactyla gerstaeckeri* Jac.: a jumping species, bright orange, very conspicuous and typically aposematic, found on same plant as No. 1, and with it. This was pulled to pieces, smelt, rubbed with the hands, and finally dropped. I picked it up and gave it to M. again; he pulled it about, but finally ate a little.

Obs. 4. *Sp.* 2.—Beetle, *Clytra wahlbergi*. Looked well at, smelt, pulled to pieces, eaten without enthusiasm.

Obs. 5. *Sp.*—.—Acridiid: a small procryptic brown grasshopper was brought to M., who was wildly excited as he saw it coming, seized it with the utmost eagerness and crunched it up with every indication of relish.

Obs. 6. *Sp.* 4.—Hesperid butterfly: a black and white "chequered skipper," was also taken and eaten with gusto.

Series B. Dec. 29.—The monkey was now in my hands, and I was able to control its feeding. About 10.30 a.m., M. being very hungry, I gave him a banana, and when about half eaten took it away and offered—

Obs. 7. *Sp.* 5.—Acridian, *Zonocerus elegans* Thunb.: a "poisonous-looking," large, freely exposed, clumsy grasshopper, bright yellow green with undeveloped reddish tegmina, and antennae ringed alternately black and orange. I put this down in front of M., who just looked at it and appeared to take no more notice.

Obs. 8. *Sp.*—.—I then took out another large Acridian, brown, procryptic. M. at once leapt up and seized it and ate it with extreme haste. Afterwards he went back to 5, smelt and touched it, but did not even taste it.

(*Note.*—This exemplifies extremely well the distastefulness of 5.)

Obs. 9. *Sp.* 1.—*Cassida* sp. This was offered, but M. took absolutely no notice of it.

Obs. 10. *Sp.* 3.—Halticid, *Physodactyla gerstaeckeri.* This beetle was treated like the last.

(*Note.*—This exemplifies that a very distasteful insect may be eaten when the monkey is extremely hungry, see Obs. 1 and 3.)

Obs. 11. *Sp.* 6.—Meloid, *Coryna dorsalis* Gerst.: a very common, medium-sized, large-bodied beetle, black with conspicuous light yellow marks on elytra, was absolutely ignored after a first glance.

Obs. 12. *Sp.* 7.—Meloid, *Mylabris tristigma* Gerst. var.: a common large black and orange beetle, with habits (like 6) typically aposematic, feeding freely exposed on flowers. M. would not even taste this, nor did he touch it.

Obs. 13. *Sp.*—.—An Acridian, of about the same size as 6, procryptic, was at once devoured with great gusto.

Series C. *Dec.* 29.—At about 5 p.m. M. had some banana, and half an hour afterwards—

Obs. 14. *Sp.* 8.—Mutillid: a medium-sized ♀ of a *Mutilla* not in the British Museum, black all over, with white abdominal spots. This was allowed to run on the ground, and M. pounced on it and hurriedly rubbed it on the ground in the manner previously described, eventually seizing it and crunching it up very quickly. I think his lips and one hand got stung.

Obs. 15. *Sp.* 9.—Another, smaller Mutillid was then put down, but M. would not have anything to do with it.

(*Note.*—Obs. 14 was the first occasion on which a

Mutillid was tested, and M. being very young had very possibly not seen one before. After he had been stung he refused a smaller species.)

Obs. 16. *Sp.* 10.—Lycid, *Lycus constrictus* Fähr., ♂: orange colour, with black-tipped elytra; the beetle having typically aposematic habits. I offered it crawling on the tip of my finger, but after a passing glance M. took no more notice. However, I induced him to pick it up, but he at once dropped it again.

Obs. 17. *Sp.*—.—A small procryptic brown Acridian was then eaten with eagerness.

Obs. 18. *Sp.* 11.—Cetoniid, *Glycyphana balteata* Deg.: this beetle of medium size, found on a flowering tree, might be considered to be "Lycoid" in colouring; head and thorax black, elytra orange with a triangular black patch anteriorly. M. picked it up, smelt it, looked carefully at it, pulled it about a little, rubbed it on the ground and then took no more notice of it.

Obs. 19. *Sp.* 12.—Eumolpid, *Pseudocolaspis* sp.: a small, inconspicuous, dull bronze, pubescent Phytophagous beetle. It was taken, nibbled and dropped.

Obs. 20. *Sp.* 13.—Tenebrionid, *Macropoda transversalis* Kolbe: a coal-black but not polished, rotund, long-legged, very active beetle which runs about over the ground and freely exposes itself. M. was not inclined to take it at first, but with a little encouragement ate it slowly and doubtfully.

Obs. 21. *Sp.* 14.—Halticid, *Polyclada* sp.: not in British Museum, Phytophagous. A beetle with orange head and thorax and black elytra; exposes itself freely on herbage. M. picked it up and smelt it, dropped it and picked it up again, pulled it to pieces and ate it with much tasting and doubt.

(*Note.*—Under natural conditions it may, I think, be taken for granted that an insect once purposely dropped would not be retrieved.)

Obs. 22. *Sp.* 15.—Carabid, *Anthia striatopunctata* Guér.: a large, active, common, black carnivorous beetle with elytra bordered with white. A powerful species furnished with large mandibles, and of a type which can eject a strongly irritating fluid. I put it on the ground near M., whose behaviour was most amusing. He rubbed his hands on the ground and would not go near it! When I made the beetle run towards him, he leapt on to me with every sign of dislike, and almost fear.

(*Note.*—I was once holding a closely allied species in my fingers about 2 feet away from my face, when the beetle ejected fluid which struck my eyebrow and caused a painful burning sensation lasting half an hour, though I at once bathed my face. Proc. Ent. Soc. Lond., 1918, pp. c, ci.)

Obs. 23. *Sp.* 16.—Acridiid, *Phymateus viridipes* Stål: a large grasshopper, about three inches long, of a hard, unpleasant, green colour, with spiny thorax edged with red. A sluggish species, found freely exposed, often quite in the open. When put on ground in front of M. it at once erected its wings vertically, showing their purplish red and black colour, but made no attempt to escape. M. looked very hard at it, took hold of one wing, let go, and again looked very hard at it, but made no attempt to eat it.

Obs. 24. *Sp.* 17.—To show that M. was not replete I then gave him a large, green, procryptic Tryxalid grasshopper, which he ate with gusto.

Obs. 25. *Sp.* 18.—Acridiid, *Cyrtacanthacris ruficornis* Burm.: lastly I gave M. this very abundant, large, procryptic grasshopper (which the Uganda natives know well and call "E'jansi"), which M. ate, as always, with great gusto, first biting the head off. This species was commonly made use of as "Staple food" afterwards.

(*Note.*—After very definite refusal of Nos. 15 and 16, M. ate with eagerness two insects of approximately the same bulk.).

Series D. *Dec.* 29.—At 5 p.m. [probably later: see Ser. C, p. 9] I took M. out hunting for himself. He ate a number of quite small insects, including young green Mantids, and one or two large Mantid egg-capsules. He found on the stems of the bushes two more of the Acridian 18, which he ate greedily. While eating one of them, seated on a bush, he suddenly saw a large mantis, *Idolum diabolicum* Saus. (*Obs.* 26. *Sp.* 19). This is an extremely procryptic leaf-green species, with leaf-like expansions on the hind femora: the sides of the thorax are prolonged laterally to form thin flattened expansions. This species frequented a certain bush whose small, closely set leaves formed admirable cover, amongst which it was extremely difficult to see the mantis, which usually hangs upside down from a stem. On this occasion, as usual, M. saw the mantis before I did, and apparently caught it unawares. It gave him a sharp pinch with its forelegs, and M. shook it away. I then made the mantis crawl along the branch on which M. was sitting, and when it got close to him the monkey apparently made a movement which frightened the mantis. It suddenly reared itself up on its two last pairs of legs, so as to stand at an angle of 45°. The fore legs were held close together, parallel with the long axis of the body, extended on each side of the head,

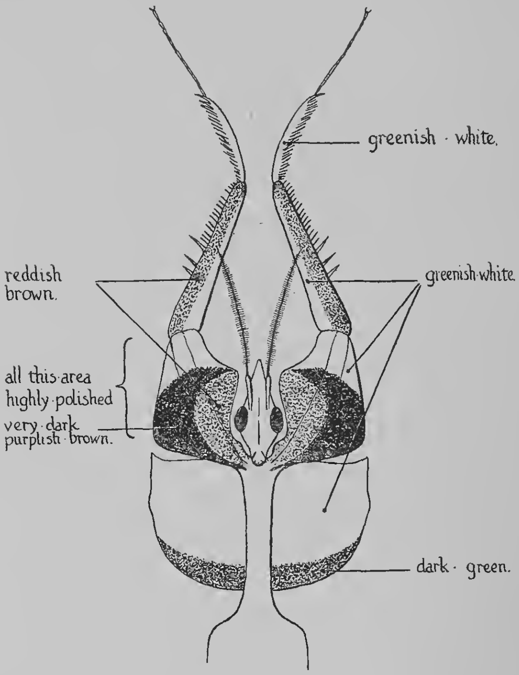

Fig. 1.

> with the broad flattened coxae rotated so that their *inner* surfaces were directed *forwards*, the two notches together leaving an oval space for the head: the flattened coxae were thus in the same plane as the broad expansions of the thorax. The result of this striking attitude may be seen in the accompanying rough sketch made from this very specimen after it was killed, and the limbs placed in the appropriate position. For some reason the fore limbs could not be made to adopt the straight position in which they were held when alive:—the tibiae and tarsi should be *close together and parallel.* This attitude shows the under surface of the thoracic expansion conspicuously greenish white, except for an inferior greener strip; the coxae basally very dark purplish brown, or almost purplish black, with the dark colour extended to form a semicircle around the reddish brown area on each side of the green head with conspicuous black eyes. The distal parts of the coxae, next the femora, are again conspicuously greenish white, as also is the strip along the inner margin of the femur whose outer part is reddish brown. The whole of the large area of the coxae is very highly polished. The general effect of this large diversely coloured area suddenly exposed in a threatening manner was extremely surprising both to me and the monkey! He hastily backed away along the branch, and I think there can be no doubt that on this occasion the mantis saved itself by its "terrifying attitude."

This most interesting mantis was described by Dr. D. Sharp as a "floral simulator" in the Proceedings of the Cambridge Philosophical Society for 1899, No. X, pp. 175, etc. Dr. Sharp says, "Mr. Muir says, like *Mantis religiosa*, it assumes very peculiar attitudes, sometimes hanging by three or even two legs, and sticking one or more of the others out like twigs.

"The front legs are invariably extended ready to close in upon the deluded prey and are never darted out as they are by *M. religiosa.* . . . I doubt if it has any special plant, but its coloured legs hanging from any tree form an attraction to flies. In order to test this I placed pieces of coloured paper on trees and noticed that flies would often fly down, and at times beetles. . . ."

In a subsequent letter Mr. Muir emphasises the fact that *Idolum diabolicum* captures its prey, as this flies down, by closing the tibia on the femur, and not by darting out the leg as other mantis do.

Dr. Sharp points out that "the points of modification are the great size of the front legs and the colour of the coxae": the appendages on the coxae are especially characteristic of *Idolum* and its immediate allies; the great shield on the thorax reaches maximum development in *Idolum*. The colour of the coxae "has a very floral appearance during life." The attitude is very unusual in that the part of the coxa which is exposed is the *inner* face, which bears the petaloid coloration. If the legs were held in the normal position this coloration would not be seen. "In short the attitude assumed by the insect is thoroughly correlated with the special modification of colour and structure."

Dr. Sharp gives a coloured drawing, in which the femora are stretched out parallel with each other, continuing the line of the coxae, but the tibiae are bent on the femora and do not continue the same line, parallel with each other, as in the "terrifying attitude."

Dr. Sharp makes no mention of this terrifying attitude. I had never heard of *Idolum* before I saw it in 1916, and did not know it was held to be a floral simulator. This never occurred to me—the coloration seemed to me to be entirely for purposes of scaring away enemies. I never noted the attitude described by Mr. Muir.

Obs. 27. *Sp.* 16.—After this interesting episode I took M. to a bush where there were two of the large, aposematic grasshoppers, *Phymateus viridipes*, in copula. M. merely looked at them, and then occupied himself with other things. Just before he moved away he put out his hand to take the ♂, as if forgetting, but at once withdrew it and went his way.

Obs. 28. *Sp.* 18.—Almost at once he caught and ate two *Cyrtacanthacris ruficornis*, each as big as the 16 which he had passed over immediately before.

Series E. Dec. 30.—At 10 a.m., the monkey having had a good feed of bananas at 9—

Obs. 29. *Sp.* 10.—Lycid, *Lycus constrictus:* this beetle was offered with elytra pulled off; it gave out a very strong odour. M. would not take it; just touched it and took no more notice.

Obs. 30. *Sp.* 20.—Cicindelid, slightly larger than our *C. campestris;* very procryptic; coloured mottled grey and brown, so that when at rest can hardly be distinguished from its surroundings. M. watched it running about, and then suddenly pounced upon it and vigorously rubbed it on the ground. He then quickly crunched it up with no signs of dislike.

(*Note.*—This well exemplifies how an insect that is eaten without sign of dislike is accorded, from fear of being bitten, the same treatment received by a very distasteful species.)

Series F. Dec. 30.—At 2 p.m., M. having had plenty of food in morning, I gave him (*Obs.* 31. *Sp.* 21) a Histerid, *Hister validus* Erichs.: a large, flat, highly polished, smooth, black beetle, with rather large and conspicuous mandibles. M. looked at it with great interest, touched it, then left it alone. I then took it up and put it down, encouraging M., who, thinking that after all it might be nice, took renewed interest in it. The beetle lay with legs closely pressed to the body, after the typical manner of a *Hister*, and the large mandibles widely separated, quite motionless. M. smelt it, rubbed it on the ground, and then started playing with it, but made no attempt to taste it.

Obs. 32. *Sp.* 22.—Acridiid, *Dictyophorus productus* Bol.: a heavy, bloated, slowly crawling grasshopper that freely exposes itself. The colour is dark grey; the short elytra expose a large part of the abdomen, tinted with a good deal of bright red. M. saw from a distance that I was bringing a grasshopper and became very excited: however, as I got nearer and its nature became plainer his excitement subsided. I put it on the ground, he took it and smelt it, and put it down again. In order to encourage him I pretended to taste it, and he then licked it, but only got a taste of the yellow froth which it exuded in small quantity: he showed every sign of disgust and would have no more to do with the insect, shaking his head as if trying to get rid of the nasty taste.

Series G. Dec. 30, 4 *p.m.*—

Obs. 33. *Sp.* 23.—Acridiid, *Cyrtacanthacris cyanea* Stoll.: another grasshopper of the type known to the Baganda as "E'jansi"—(see 18)—procryptic, brown with yellow marks, and in flight showing purple wings. This specimen was a ♀ about 4 inches long. M. seized this, with the greatest eagerness, by the body, biting off the head. The insect kicked so strongly with its spiny hind legs that M. was considerably inconvenienced by them and with a little noise of protest bit the hind legs off, eating the muscular femora, and discarding the spiny tibiae, with the exception of which the whole of this large insect was eaten. This species formed one of the staple articles of food in later experiments.

Obs. 34. *Sp.* 24.—Tenebrionid, *Physophrynus*, an undescribed new species: large, rotund, black beetle, much like 13 in habits and general appearance, but considerably larger. M. was not much interested in this; it lay on the ground with legs held stiffly. He looked hard at it, licked it, gave it a gentle bite which made no impression owing to the hardness of the integuments, and then put it down with an air of having had quite enough of it, and rubbed it on the ground. I induced him to try again; he gave it some more gentle bites which made no impression on it, and pulled its head off, but would not eat any of the viscera that came out.

Obs. 35. *Sp.* 25.—Carabid, *Polyhirma*, a species not in the British Museum: a member of a synaposematic group of ground-beetles characterised by black colour with a pair of dull white markings on the elytra, and sometimes an anterior, median, longitudinal, white line along the elytral suture. This specimen was one of the smaller and more delicate members of the group. M. would not touch it, and merely rubbed his hands on the ground.

Obs. 36. *Sp.* 26.—Curculionid: a ground-weevil, earthy brown in colour, with hard and rugose elytra, of slow movement. At rest quite procryptic. This was eaten with relish and without hesitation.

Obs. 37. *Sp.* 27.—Elaterid: a medium-sized, "ordinary looking," brown species of "click beetle." This was also eaten with relish.

Obs. 38. *Sp.* 28.—Hemipteron: a solidly built, rose-pink, wingless bug found freely exposed on a dead tree. I quite expected that M. would have nothing to do with this very aposematic bug, but he tasted it cautiously, and then ate it slowly and uncertainly. I was much surprised at this, and thought that as M. was in a very frolicsome mood he had perhaps not selected very carefully.

Obs. 39. *Sp.* 29.—Hesperid, *Rhopalocampta forestan* Cram.: this large skipper had been previously quieted a little in the cyanide-bottle. It was inspected, smelt, licked, and finally eaten with relish, wings and all.

(*Note.*—Sufficient time had elapsed for any taint of cyanide to disappear.)

Obs. 40. *Sp.* 30.—Tachinid, *Chromatophania distinguenda* Vill.: a large fly with very conspicuous pink body and brown wings. It had been quieted by the killing-bottle. M. picked it up and threw it down twice, but would not taste it.

Obs. 41. *Sp.* 31.—Reduviid: a slender black bug speckled with yellow; not very conspicuous. M. ate it cautiously.

Obs. 42. *Sp.* 32.—Meloid, *Cyaneolytta coelestina* Haag.: a large, heavy, purple beetle, like *Meloe* (the "oil-beetle"). M. was very decided about this; looked at it and at once rubbed it on the ground and then left it. I put another where he could get at it, and he, being in a very frolicsome mood, played about with it and at last tasted it. He afterwards shook his head and made wry faces.

Obs. 43. *Sp.* 33.—Mantid: two very young black specimens found running on a road. One looked ant-like; the other had a white spot on the abdomen and was rather like a generalised type of *Mutilla*. M. ate them both without delay.

Obs. 44. *Sp.* 34.—Acridiid, *Humbe tenuicornis* Schaum.: a large, earth-brown, very procryptic grasshopper which shows yellow wings with black border when flying. This was eaten with relish.

Obs. 45. *Sp.* 35.—Tryxalid: a large, green and brown, very procryptic grasshopper which shows mauve wings when flying. M. saw the colour of these as I threw it down, but ate the insect with relish, without hesitation.

Series H. Dec. 30.—At 5 p.m. I took M. out hunting among the bushes—

Obs. 46. *Sp.*—.—He discovered and ate at least four large "jansi" grasshoppers (*Cyrtacanthacris*), and (*Obs.* 47. *Sp.*—) two fat egg-capsules of a mantis, probably Species 19.

(*Note.*—He very soon became extraordinarily fond of these and would eat large numbers. They were spherical, and of about the size of a small walnut; of a creamy white colour and quite conspicuous. He would only eat them when the eggs had not yet hatched.)

Obs. 48. *Sp.* 2.—Clytrid, *Clytra wahlbergi:* one of these beetles was sitting very conspicuously on a low branch, and as M. was then on my arm I directed his attention to it. But he only looked past it at a small grasshopper, to get which he jumped down, and ate it. I could not make him take any notice of the aposematic beetle even when I threw it down in front of him.

Series J. Dec. 31.—At 8 a.m. M. had some banana, but was *very hungry for insects.*

Obs. 49. *Sp.* 5 was offered, but M. was obviously disappointed and would not take it.

Obs. 50. *Sp.*—.—A green Tryxalid grasshopper was eagerly devoured.

Obs. 51. *Sp.* 14.—Was dropped on ground. M. ate it, but without eagerness.

Obs. 52. *Sp.* 2.—Put on ground, but M. would have nothing to do with it.

Obs. 53. *Sp.* 36.—Tenebrionid, *Lamprobothris fossulata* Müll.: an elongated, dull purple, shagreen beetle found on stem of a bush, not very conspicuous. M. at first ignored it, then bit its head off and ate it slowly, without enthusiasm.

After this I gave M. more banana and some small Acridians.

Series K. Dec. 31.—At noon I gave M. a "jansi." He was very eager for it, squealing excitedly as I brought it near, and ate it greedily.

Obs. 54. *Sp.* 37.—Galerucid, *Megalognatha* sp.: a small, abundant, freely exposed beetle frequenting low bushes. Head, thorax and antennae black, elytra light brown. In the pregnant ♀ the abdomen, much swollen with eggs, is bright yellow, with the segmental rings black. M. would have nothing to do with this, not even smelling it.

Obs. 55. *Sp.* 38.—Cassidid, *Aspidomorpha hybrida* Boh.: a medium-sized, dull-bronze "tortoise-beetle." It was offered on my finger; M. at first ignored it, then tasted and dropped it.

Obs. 56. *Sp.* 39. Reduviid: an elegant, grey bug with reddish patch at tip of tegmina. Eaten with no sign of dislike.

Obs. 57. *Sp.* 40.—Pentatomid larva: a flat, grey bug with enormously long rostrum, quite procryptic, bark-like. A young specimen, as tegmina not developed. Eaten, but slowly and without relish.

Obs. 58. *Sp.* 41.—Pentatomid, *Callidea bohemani* Stål: a large, bright green and gold bug. M. looked at it disappointedly when I took it out of the box, but took it, smelt it, and dropped it with an air of finality.

Obs. 59. *Sp.* 38.—Cassidid, *Aspidomorpha hybrida*: another specimen of this tortoise-beetle was pulled to pieces, uneaten.

Obs. 60. *Sp.*—.—A large *Cyrtacanthacris* grasshopper was eaten with great eagerness.

Obs. 61. *Sp.* 42.—Coreid, *Anoplocnemis curvipes* F.: a large, plant-feeding bug, black, with the hind femora much thickened in the male. Quite conspicuous, as it sits among green leaves, preferably on tips of young shoots, but takes to the wing more readily than a typically aposematic species. M. appeared to recognise that this might be formidable—it was vigorously rubbed on the ground, then eaten, but not with gusto.

Obs. 62. *Sp.* 43.—Buprestid, *Sternocera pulchra* Waterh.: a very large, conspicuous beetle. Thorax covered with orange pubescence, elytra blue-green. Flies very conspicuously with loud hum, and sits on twigs freely exposed. I quite expected M. to refuse this beetle. He looked at it, patted it, smelt it, and then backed away from it; and I could not induce him to taste it. The beetle opened widely the gap between posterior edge of thorax and anterior margin of elytra, but I could detect no odour.

Obs. 63. *Sp.*—.—A small, procryptic Acridian then eaten with great zest.

Series L. *Dec.* 31.—In the afternoon—

Obs. 64. *Sp.* 44.—Pentatomid, *Aspongopus viduatus*

F.: a large, flat, black and brown bug, caught on the wing. It was put down in front of M. (who had seen it flying), and he, very eagerly, and without having examined it much, gave it a nip. The result was apparently unpleasant, for he threw it down and ran away. I was not sure whether the bug had pricked him with its rostrum, or whether he objected to its strong flavour; he smelt strongly after biting it, and his mouth was obviously very uncomfortable.

Obs. 65. *Sp.* 45.—Carabid, *Polyhirma calliaudi* Casteln.: a medium-sized ground-beetle, black, with dull white marks, of the same general type of colour as 25, but larger. M. would have nothing at all to do with it, and did not even rub it on the ground, in spite of my attempts to induce him to pick it up.

Series M. *Dec.* 31.—

Obs. 66. *Sp.*—.—At 4 p.m. gave M. a *Cyrtacanthacris* grasshopper and then—

Obs. 67. *Sp.* 43.—Buprestid: the large beetle *Sternocera pulchra*, but M. only touched it and would have no more to do with it.

Obs. 68. *Sp.* 46.—Tenebrionid, *Vieta* sp. ? *vestita* Gory: a medium-sized ground-beetle, earth-coloured, with very rough and bristly elytra. M. touched it as it ran, and apparently did not like the feel of it, for he at once rubbed it on the ground and would have no more to do with it.

Obs. 69. *Sp.* 47.—Buprestid, *Agrilus discolor* Fåhr.: a beetle of bright colouring, quite conspicuous on a leaf. Grey and black with orange markings; abdomen ventrally black and brilliant white. The dorsal colouring is rather reminiscent of a type of colouring common among Hemiptera. A pair was found in copula, and the larger female offered to M., who looked at it with great interest, took it and bit its head off, then slowly pulled it to pieces and ate it bit by bit as if not sure about it.

Series N. *Jan.* 1.—At 7 a.m., before M. had eaten anything, I gave him the Buprestid beetle 43 *Sternocera pulchra*. (*Obs.* 70. *Sp.* 43). Though very hungry he did not really want it, but after hesitation tried to bite off its head. This was difficult, as the beetle was very hard and slippery and he couldn't get a grip. Also he got the tip of his tongue nipped between the beetle's thorax and abdomen! However, by persistent efforts he at last bit the head off and ate the beetle very slowly and with no evidence of pleasure. Later, he ate a banana and (*Obs.* 71. *Sp.*—) two small Acridians, and then I offered—

Obs. 72. *Sp.* 48.—Chrysomelid, probably *Lygaria* sp., not in British Museum: a pink and black, medium-sized beetle like a ladybird, one of two found in copula. M. looked at it for some time and then cautiously ate it without apparent enjoyment.

Obs. 73. *Sp.* 49.—Lampyrid, *Luciola* sp., not in British Museum: a firefly about the size of the English ♂ glow-worm, dull grey, with yellow thorax. This was smelt and most definitely refused.

Series O. Jan. 1.—At 9 a.m. I took M. out hunting on a lead—

Obs. 74. *Sp.* 50.—Coccinellid, *Alesia striata* F.: a common, small, rose-pink ladybird, with three black longitudinal stripes, found on tops of long grass. I offered this to M. and rather to my surprise he ate it.

Obs. 75. *Sp.*—.—He then found and ate a *Cyrtacanthacris* grasshopper.

Obs. 76. *Sp.*—.—While eating this he saw a mantis egg-capsule, and took that.

Obs. 77. *Sp.* 42.—Coreid: soon after, he saw a black bug (*Anoplocnemis curvipes*) and attempted to catch it, but it flew away.

Obs. 78. *Sp.* 14.—Halticid: I found one of these *Polyclada* beetles, but could not induce M. to take it.

Series P. Jan. 1.—In the evening, after M. had had a good feed of bananas and at least one *Cyrtacanthacris* grasshopper in the afternoon, I again took him out hunting. In this series, each different bush visited is indicated by a letter.

Obs. 79. *Sp.*—.—A. M. ate a ♂ *Cyrtacanthacris* and another smaller Acridian.

Obs. 80, *Sp.*—.—B. Ate two *Cyrtacanthacris* in quick succession.

Obs. 81. *Sp.*—.—C. Investigated an empty spider's "nest."

Obs. 82. *Sp.*—.—D. Ate a mantis egg-capsule.

Obs. 83. *Sp.* 51.—E. Coccinellid: a large, bright pink and yellow ladybird with black pattern was eaten. I then let M. loose. He ate some leaves of a herb tasting like sorrel, and began to get very playful and inclined to play hide-and-seek.

Obs. 84. *Sp.*—.—F. A mantis egg-capsule, probably empty, munched, and thrown away.

Obs. 85. *Sp.*—.—G. Another similarly treated. M. then ate some grass, unsuccessfully chased some small grasshoppers (Acridiidae) and ate some more grass, keeping one eye on a large crane high overhead, which I had not seen.

Obs. 86. *Sp.*—.—H. Ate a *Cyrtacanthacris* grasshopper.

Obs. 87. *Sp.*—.—I. Investigated an empty spider's retreat.

Obs. 88. *Sp.*—.—J. Ate a large mantis egg-capsule, of the size of a small walnut.

Obs. 89. *Sp.*—.—Found another, bit and left it.

Obs. 90. *Sp.*—.—I showed him on the ground a smooth caterpillar, dark brown and reddish, but he would not touch it. Though freely exposed it was not extremely conspicuous.

Obs. 91. *Sp.*—.—K. Ate a medium-sized, brown Acridian.

Obs. 92. *Sp.* 19.—He then walked about, constantly looking up at the under-side of a leafy branch close to the ground, whereon was something I could not see, or perhaps had failed to see. Suddenly there was a pounce, and I saw that he had pulled on to the ground one of the large mantises *Idolum diabolicum*, which lay on the ground in two pieces, which he ate greedily.

Obs. 93. *Sp.*—.—He then ate two more mantis egg-capsules.

Obs. 94. *Sp.*—.—L. Investigated an empty spider retreat.

Obs. 95. *Sp.* 19.—M. On this bush, hanging upside down on a branch near the ground, was another *Idolum* mantis. M. at first was not at all sure that he wanted it, but at last knocked it on to the ground. Here it stood in the erect posture previously described, facing the monkey and me, looking very ferocious and formidable; the white under-surface of the thoracic expansions being especially noticeable. M. had quite a little fight with the mantis, going " in " and " out " like a pugilist. During the fight I heard a curious noise (which I described in my notes as like a small sneeze with a click in it) which I believed was made by the mantis, but could not see how. The poor mantis was eventually overpowered and eaten.

Obs. 96. *Sp.*—.—The monkey then ate another *Cyrtacanthacris.*

Obs. 97. *Sp.*—.—N. Another eaten.

Obs. 98. *Sp.* 52.—Longicorn, Lamiid, *Dirphya similis* Gah.: while M. was on a branch there suddenly flew out this large beetle, with loud buzzing. On the wing it was very conspicuous and resembled a large Braconid. The long antennae black, the head, thorax and anterior half of the elytra bright orange, posterior half of elytra black. On the sides of the abdomen are glistening white marks. I caught the beetle, and put it on the ground in front of M., who merely looked at it. When I put it on my finger (which it bit very hard), stridulating loudly, M. would not go near it and backed away if I approached it to him.

Obs. 99. *Sp.* 52.—Next morning, early, before M. had had anything at all to eat, I offered this beetle again. Being very hungry he took it, smelt it, and rather doubtfully bit its head off, and ate it slowly.

(*Note.*—These two observations are very instructive in showing the difference made to a monkey by hunger. It is extremely likely that in the evening he had actually *seen* the beetle and passed it by, for it is large and does not hide itself.)

From this point the observations have only been quoted in cases of particular interest.

Series Q. *Obs.* 100–114. *Jan.* 2.—At 10.30 a.m. M. was taken out on the lead. He had had very little *insect* food, and was hungry.

Obs. 113. *Sp.* 58.—[The Acridians *Tanita* sp. and *T. semlikiana* Rehn bear this number. Both have red wings and tegmina either grey or green.—E.B.P.] A very procryptic, stone-grey, small Acridian got up in front of me as I walked, and I let M. get down to catch it where it had settled. He failed to find it, and saw its conspicuous red wings as it flew away. He then caught it, but did not eat it at once, looking at it *as if to see where the red wings had gone to.*

(*Note.*—I consider this point of great importance. See later.)

Series R. Obs. 115. *Jan.* 2.—In the evening, M. having had as much vegetable food as he could eat, I took him a large Sphingid caterpillar of the *Deilephila* type (*Sp.* 60), pale apple-green, with the usual spots on two of the enlarged anterior segments. These spots, however, could not be described as "Eye-spots" (though they could develop into such), as they consisted merely of dull yellow patches ringed with black. M. was *very* excited when he saw me bringing the caterpillar on its food-plant, and I kept it for a while just out of reach to let him see it well. I then let him take the stem on which was the caterpillar; he looked at the latter attentively and licked its head. It drew back the head into the enlarged segments behind, and bent the anterior part of the body round, parallel to the posterior part. This did not, however, prevent the monkey eating it with enjoyment, though he seemed to find much the same difficulty with it as a boy with a chocolate éclair! Watching him I concluded that he was not familiar with such soft, squashy insects.

(*Note.*—This attitude of the caterpillar was extremely interesting because although, in this species, it was of little importance, in others which have eye-like marks the swelling of the segments bearing them, caused by the attitude, must very considerably increase the "alarming" effect of the eyes. (See Poulton's "Essays on Evolution," Oxford, 1908, p. 367.) It is tempting to suppose that this attitude, common to this type of larva, preceded the development of the spots described above into a more eye-like stage, which would thus be rendered more effective.)

Series S. Obs. 116–134. *Jan.* 3.

Obs. 116. *Sp.* 22.—At 7 a.m., before M. had had any food at all, I offered the Acridian, *Dictyophorus productus.* M. looked very hard at it, took it, turned it over and over, and pulled its legs. He then licked a little of the froth which exuded, white, from the side of the thorax, and dropped the grasshopper for good. He then ate some banana.

(*Note.*—The fact that the legs of this species did not come off when pulled may be another example of the well-known toughness of aposematic species. In a typically procryptic, jumping grasshopper the hind legs are easily dispensed with. *Dictyophorus* does not readily exude froth, and when it does so, only a little, cp. *Sp.* 22, p. 15.)

Obs. 117. *Sp.* 61.—At 8 a.m., M. having eaten no insects, I gave him the Syrphid fly, *Eristalis tenax*, much resembling the honey-bee. I held it by the legs so that it buzzed. M. was not at all keen, but took it in his hand and then suddenly let it go precisely as if he had been stung. I think he was very uncertain about this mimetic insect, and perhaps it buzzed in his hand and his imagination was too strong for him!

Obs. 128. *Sp.* 65.—Lygaeid, not in British Museum: probably a *Lygaeus*, a conspicuous black and red bug. One which had been turned out on to the ground took to flight suddenly; M. pounced on it and hastily bit off its head. This he violently spat out, and his gestures and expression gave every sign of a very disgusting taste. He then went and ate some mango!

Obs. 129. *Sp.* 67.—Asilid, *Hoplistomerus serripes* F.: a large predaceous fly whose abdomen is covered with dense golden pubescence; the wings are clouded. Found sitting on a leaf one evening it much resembled a Scoliid, the large bristles characteristic of Asilid flies being suppressed. I opened the box in which it was and let M. see it. He looked closely at it, but with suspicion. Just as it was about to fly I caught it by the legs, so that the yellow surface of the abdomen, concealed when the wings were at rest over the back, was visible. M. would not catch hold of the fly, though he once put out his hand and touched it. Eventually it flew away. M.'s behaviour most strongly suggested that he was afraid of this harmless insect.

Series T. *Obs.* 135–138. *Jan.* 3.

Series U. *Obs.* 139–148. *Jan.* 3.—At 5 p.m., after M. had eaten some banana—

Obs. 142. *Sp.* 73.—Asilid: a large, hairy, predaceous fly, grey in colour. This had been quieted in the killing-bottle so that when I opened the box in which it was it crawled out. Just as it made ready to fly M. seized and ate it eagerly.

(*Note.*—This is interesting because M. had refused to have anything to do with the previous Asilid, mimetic of a Scoliid. It strengthens the supposition that the mimicry was real enough to make M. suspicious.)

Obs. 144. *Sp.* 42.—Coreid, *Anoplocnemis curvipes:* while M. was eating a favourite *Cyrtacanthacris* grasshopper with a piece in each hand, I put down one of these black malodorous bugs. M. was very amusing, as he was afraid it would get away and yet did not want to relinquish what he was actually eating. At last, at its third attempt to fly away (I had frustrated previous efforts) M. dropped the remains of his grasshopper to seize the bug, which, as before, was eaten with great eagerness.

(*Note.*—The fact that M. dropped a piece of his favourite food to secure this bug shows what he thought of it.)

Obs. 145. *Sp.* 24.—Tenebrionid, a species of *Physophrynus:* the beetle was put on the ground, but M. only just looked at it. Eventually, being in playful mood, he threw it about and rolled over with it, but would not taste it.

Obs. 146. *Sp.* 74.—Curculionid: a very large ground-weevil, in general appearance remarkably resembling 24, dull grey-black, and of slow habit. After close inspection M. tried to bite it, but it was so hard that at first he could make no impression on it. He at length "cracked" it, and broke off the elytra and dorsal plate of the abdomen, exposing bright yellow viscera. He seemed rather surprised at this, but ate them, with much tasting.

Obs. 147. *Sp.* 75.—Lamiid, probably *Phantasis zanzibarica* Gerst.: a very remarkable, rotund, bulky, grey-black Longicorn beetle, having a strong general resemblance to 74 (and, in less degree, to 24) save for the antennae, which were short for a beetle of this family. It was found walking slowly across a road, within a few yards of 74. It had lost the power of stridulating possessed by the family as a whole. The shallow longitudinal grooves of the elytra are set with fine bristles. I put it down before M., who merely looked at it, without any desire to eat it. At last he touched it, and apparently not liking the bristly feel of it, rubbed it on the ground and left it.

(*Note.*—These last two species, though not aposematic by colouring, yet are by habit. The weevil would seem to be protected by its extreme hardness: the Longicorn (also found to be very hard) apparently by its bristles. The very unusual shape of the Longicorn raises the question whether it may not be influenced by the abundant 74. See "Essays on Evolution," pp. 369, 370.)

Obs. 148. *Sp.*—.—Lastly, I gave M. an Acridian. He seemed nearly "full," for though it was a species which he eats readily as a rule, he was not very eager for this one.

Series V. *Obs.* 149–153. *Jan.* 4.

Series W. *Obs.* 154–155. *Jan.* 4.

Series X. *Obs.* 156–175. *Jan.* 4.—At 4.30 p.m. I took M. out hunting. He had had plenty of vegetable food in the afternoon, but no insects.

Obs. 156. *Sp.* 6.—Meloid: on the first bush were several of the beetle *Coryna dorsalis.* I induced M. to put out a hand and touch one, but he would not even smell it.

Obs. 157. *Sp.* 42.—Coreid, *Anoplocnemis curvipes:* M. saw this bug, caught it, and ate it very quickly, as if afraid of being pricked.

Obs. 158. *Sp.*—.—He chased and ate a small Acridian, then ate some grass.

Obs. 159. *Sp.* 78.—An Arctiid caterpillar, about an inch long, was touched and left.

Obs. 160. *Sp.* 16.—Acridiid, *Phymateus viridipes:* a pair of these aposematic grasshoppers were in copula freely exposed on short grass in the open. M. went up to them and pawed the male. Without attempting to get away the grasshopper merely erected its wings perpendicularly so as to display their purplish and black colours. M. took no more notice and ate some grass. Afterwards he ate other insects, including a large *Cyrtacanthacris* grasshopper.

(*Note.*—This exemplifies excellently the instinct of an aposematic insect to make the most of its colours without attempting to escape. Had it done so, the monkey might well have pounced on it and maimed it, even though he would not eat it afterwards. The coloured wings are extremely conspicuous when the insect is on the wing, its flight being slow and laborious, and direct one's attention very emphatically to it.)

Obs. 168. *Sp.* 81.—Phasmid: I saw M. looking very carefully at the top twig of a low bush, round the foot of which he walked, and then suddenly took from it a brown stick-insect about two inches long, a species commonly found among grass. Presumably at first M. was not sure of it and it then gave itself away by moving.

Series Y. *Obs.* 176. *Jan.* 5.

Series Z. *Jan.* 12.—Since last observation I had been away. The monkey had had very little insect food during that period. In afternoon, M. having had some banana, I offered him—

Obs. 177. *Sp.* 86.—Lycid, *Chlamydolycus trabeatus* Guér.: a ♂, with elytra enormously developed, projecting far beyond the small body—a very conspicuous beetle. M. looked well at it, at last taking it in his hand and dropping it again. I could not induce him to do more than smell it once, when he instantly dropped it.

Obs. 178. *Sp.* 87.—Lygaeid, *Oncopeltus famelicus* F.: conspicuous black and orange bug. M. was not at all eager for this, but took it, pulled it about, bit its head off, and then had no more to do with it.

Obs. 179. *Sp.* 88.—? Coccinellid, or allied family: a very highly polished, shining, black, hemispherical beetle, with two small red spots. It gave out yellow juice when handled. To my surprise M. ate this with no sign of distaste.

Obs. 180. *Sp.* 89.—Carabid: small, dull-black ground-beetle like a *Harpalus*. M. also ate this.

(*Note.*—Seeing how hungry for insects the monkey was, as evidenced by his eating the Carabid, his refusal of the Lycid is the more emphatic.)

Series Aa. *Jan.* 13.—At 8 a.m., M. having had no insect food—

Obs. 181. *Sp.* 86.—Lycid, *Chlamydolycus trabeatus*: as M. was hungry he pulled this beetle to pieces, and smelt each bit, but tasted none.

Obs. 182. *Sp.* 44.—Pentatomid, *Aspongopus viduatus*: shown to M. in a box. He looked at it for a very long time; the bug moved a little, and vibrated its short antennae very rapidly, and M. turned away from it. I brought it to his notice again, and he pawed it a little: just as I was taking it away for record, M., purely out of mischief, and because he saw I wanted it, took it and bit it up. I am quite certain he did not want it as food: and he did not bite it up with any relish!

Obs. 183. *Sp.* 21.—Histerid, *Hister validus:* during the day I saw M. playing about with one of these polished black beetles, and pawing it on the ground, but making no attempt to eat it. It had flown by, and alighted on the ground within his reach.

Series Ab. *Obs.* 184–189. *Jan.* 13.—At 10.30 a.m. I took M. out hunting—

Obs. 185. *Sp.* 23.—M. caught and ate the huge Acridian *Cyrtacanthacris cyanea*, a ♀, absolutely ignoring (*Obs.* 186. *Sp.* 22) the aposematic grasshopper *Dictyophorus productus*, which was on the ground just in front of him.

Series Ac. *Obs.* 190–200. *Jan.* 13.—At 2 p.m. I took M. out hunting again, but he was rather sleepy—

Obs. 193. *Sp.* 91.—Acridiid, *Lamarckiana loboscelis* Schaum.: a ♀, of huge size, heavy and corpulent, without a trace of wings. This species is coloured so as to resemble a clod of earth; sometimes light, sometimes dark, but always with a darker patch on the thorax. I have often seen them sitting on bare ground and mistaken them for clods until they moved. They hop very feebly and cannot possibly escape an enemy.

M. found this one on the ground and began to eat it before I saw it. He bit the head first, but did not bite it off, as he does with his favourite *Cyrtacanthacris*. He seemed rather doubtful about it, and turned to a leg, eating one thigh; then bit off the end of the abdomen, pulled out and ate the viscera, but his manner of eating was not nearly so enthusiastic as when dealing with *Cyrtacanthacris*. He finally bit off and ate the head.

(*Note.*—The case of this huge, helpless Acridian seems to me extremely interesting—a species which, in its present condition, is procryptic, and yet appears not to be so edible as its colouring suggests. Now it is an *extremely variable species:* under certain conditions it may be conspicuous. I have seen a quite light grey-brown specimen on dark soil, and it was then far from being procryptic. As I have said, it always has a dark patch on the sides of the thorax; and being so variable, one can readily imagine the light colour being accentuated, until a strongly contrasted scheme of black-and-white, typically aposematic, could easily be produced. This having been attained it would obviously be to the advantage of the conspicuous insect if further development of the distasteful quality, apparently already present to a slight degree, could be brought about. So that in the last stages this species might be as typically distasteful and aposematic as the Acridian No. 5, which still retains imperfectly formed wings.)

Obs. 194. *Sp.* 19.—Mantid: while M. was dealing with 91, which he ate sitting on a bush, he kept looking with great interest at a fine ♀ mantis, *Idolum diabolicum* (19), which was hanging from the same branch on which he was sitting. Its head was towards M., and it had stretched out its fore limbs in the terrifying attitude previously described, so that M. looked straight down upon the coloured surfaces. While he continued to eat 91, I made a slight movement, and the mantis at once wheeled round to present *me* with its coloured surfaces. At intervals I heard the curious sound described in Obs. 95; it is perhaps better described as like the noise made by drawing a hard edge rapidly over the fine teeth of a comb.

I was much pleased to see that this noise actually *was* made by the mantis, by drawing the left posterior leg rapidly along the outer edge of the left tegmen (the two tegmina being slightly separated); the point where the leg touched the tegmen was just proximal to the leaf-like expansion on the leg. Like myself, M. observed all this with interest while he was eating 91, but at last could wait no longer, dropped the remainder of 91, and seized the poor mantis, and devoured it very rapidly: *too* rapidly, for he was almost immediately sick! I expect the horny legs (for he ate even the spiny fore-legs) were too much for his stomach.

(*Note.*—It seems as if familiarity with this mantis had bred contempt. The monkey had seen several of them, for they were quite abundant on the particular low bushes where I took him to hunt. Under natural conditions a monkey might only come across one or two in his lifetime, and leave them alone, as my monkey did the first time he met one. It is difficult to believe that the elaborate development of colour, shape, attitude, and specialised movement and structure to make a noise, could have been developed unless it had been able to scare away enemies at least fairly often. When at rest the mantis is extremely procryptic, the concealment being especially aided by the sundry expansions of the cuticle on its body and legs. But the much-expanded front coxae take no especial part in this procrypsis, for when the mantis is at rest they lie in the *vertical* plane; and are not conspicuous, their strongly contrasted coloured surfaces facing each other, the outer surface being green. Only when the mantis is alarmed are they rotated through a right angle to contribute to the terrifying attitude. It is interesting that when the front legs are held in the terrifying position their formidable prehensile qualities are entirely thrown away!)

Series Ad. *Obs.* 201–211. *Jan.* 14.

Series Ae. *Obs.* 212–229. *Jan.* 14.—At 12.30, M. being very hungry—

Obs. 212. *Sp.* 100.—Carabid: a larva about an inch long, black, polished, and active. Allowed to run on the ground. M. looked at it, and rubbed it on the ground without attempting to eat it.

Obs. 213. *Sp.* 101.—Lygaeid, *Lygaeus militaris* F.: a grey-black and rose bug. M. looked at it and rubbed it on the ground, making no attempt to eat it.

Obs. 214. *Sp.* 48.—Chrysomelid, *Lygaria* sp.: M. ate one of these beetles slowly and doubtfully; also a second which was offered.

Obs. 215. *Sp.*—.—Acridiid: a large *Cyrtacanthacris* greedily eaten.

Obs. 216. *Sp.* 61.—Syrphid, *Eristalis tenax:* this drone-fly had been quieted by a short time in the cyanide-bottle, and was put on the ground so that M. could watch it crawling about. He looked at it with great suspicion, then took it in his hand, but threw it down exactly as if it had stung him and rubbed it on the ground. The drone-fly then flew away.

(*Note.*—Exactly the same thing happened as on the previous occasion. (See Obs. 117.) Presumably the drone-fly buzzed in the monkey's hand, and he threw it down, fearing a sting: the fact that he subsequently accorded it the treatment given to insects of whose sting or bite he is afraid, shows how entirely M. was deceived by the bee-like appearance of this fly.)

Obs. 217. *Sp.* 5.—Acridiid, young, possibly the first stage of 5, *Zonocerus elegans:* I found several score of these grasshoppers clustered thickly together to form a conspicuous mass among grass; they are black, finely spotted with yellow. I put down a number on the ground in front of M., who was not at all excited (as he would have been were they edible), but took one, pulled it about, smelt it, played with it, but did not even taste it.

(*Note.*—This exemplifies well how distasteful insects, each individually not very conspicuous (in this case because of small size), are able to achieve the aposematic effect by massing themselves together. ("Essays on Evolution," pp. 318-20.) Procryptic insects are not found to do so, except in rare cases where an assemblage would increase the procryptic effect, or at least not diminish it.)

Obs. 218. *Sp.* 103.—Pierid, *Terias senegalensis* Boisd.: a common small sulphur-yellow butterfly, of weak flight. M. ate it with no sign of distaste, wings and all.

Obs. 219. *Sp.* 104.—Acraeine, *Acraea caldarena* Hew., *neluska* Oberth.: a pink butterfly of medium size, black-spotted. I have noticed that, for an *Acraea*, this is very agile and difficult to catch. M. seized it at once (the wings of one side had been amputated so that it fluttered without being able to escape), bit its head off, and promptly spat it out! the body was pulled to pieces, tasted, and decidedly rejected.

Obs. 220. *Sp.* 105.—Coprid, *Phalops laminifrons* Fairm.: a small, bright metallic green dung-beetle. Put on the ground, M. rubbed it violently with every sign of marked dislike. I induced him to take it and smell it, but nothing more.

Series Af. *Obs.* 230–250. *Jan.* 15.—At 7 a.m. took M. out hunting, he not having eaten.

Obs. 243. *Sp.* 19.—Mantid, *Idolum diabolicum:* M. seized this very suddenly and ate it quickly before it had had opportunity to stridulate more than two or three times. He must have seen it from some distance away, for he jumped on to the branch and made straight for it, giving it no time to fight him. He did not, on this occasion, eat the horny front legs : perhaps he remembered vomiting on the last occasion (Obs. 194).

Series Ag. Obs. 251–254. *Jan.* 15.

Series Ah. Obs. 255–263. *Jan.* 15.—At noon, M. being hungry—

Obs. 259. *Sp.* 61.—Syrphid, *Eristalis tenax :* this drone-fly had been quieted in a killing-bottle, but could crawl about. M. looked at it very suspiciously as it sat on the grass, then took it in his hand and threw it down precisely as he had done before (Obs. 117, 216). I induced him to take it up again : he gave it a little nip very gingerly, and threw it down.

Obs. 260. *Sp.* 120.—Nymphaline, *Hypolimnas misippus*, ♀ : the well-known brown, black, and white mimic of *D. chrysippus*. The wings of one side had been cut off. The butterfly was offered to M. so that he could see it plainly. He took it and looked at it very thoroughly, and then put it into his mouth, holding the body in his teeth and pulling off the wings. He ate it slowly, with a good deal of mouthing, and evidently did not find it very palatable.

Series Ak. Obs. 264–282. *Jan.* 15.—At 5 p.m. I took M. out hunting; owing to a thunder-cloud he was not very eager.

Obs. 271. *Sp.* 6.—Meloid, *Coryna dorsalis :* M. saw this conspicuous beetle on a bare stem. He ran to it and touched it. It dropped and he left it.

(*Note.*—This was the first occasion when hunting that M. had taken any notice of this common and conspicuous beetle, which could be seen everywhere on low herbage.)

We then had to shelter from a storm, after which I took M. to an old patch of cultivation, now weed-grown.

Obs. 272. *Sp.* 58.—Acridiid : M. caught a ♂ of this grasshopper, a species of *Tanita*, procryptic, and ate part of it. He then saw the red wings, and hesitated a little, then continued, rather in doubt, and finally dropped it. Remains kept for record.

(*Note.*—This observation is of peculiar interest. There is a small, grey or greenish-brown grasshopper which, at rest, is extremely procryptic, and difficult to see. Yet when it takes to flight with a clapping noise its red wings seem at once to give it away. I had previously been a good deal puzzled by this: the explanation seemed to lie in the rapid flight and sudden disappearance of the insect when it closes its wings confusing the observer—as it certainly always does me when I try to find them at the place where I think they must be, judging from the point where I last saw the red wings! ("Essays on Evolution," pp. 303-4.) As a matter of fact they never *are* there, for the moment they have landed from their flight they hurriedly creep away and hide. The monkey, however, seemed most definitely to regard the red wings as an aposeme (cp. also Obs. 113). He began to eat what appeared to be a procryptic insect, saw an aposeme, and found the insect was not so edible after all! It would be most interesting to know whether this insect, now in an apparently intermediate stage as regards edibility, is losing its former edibility combined with procrypsis, or is becoming procryptic and edible from a more distasteful ancestor! I incline to the former alternative.)

Obs. 273. *Sp.* 16.—Acridiid, *Phymateus viridipes:* one of these was on a branch above M.'s head. He ran backwards and forwards looking at it, and jumping up in a half-playful way. I got it for him and put it on the ground, but he would have none of it! He then ate some grass.

Obs. 282. *Sp.* 124.—*Rhynchium* sp.: while M. was examining something on a bush this wasp flew out: a black species with blue-black wings; the tip of the abdomen conspicuously white. It soon settled on the ground, and M. went to look at it. He pawed it violently on the ground and then left it.

Series Al. Obs. 283–285. *Jan.* 16.

Series Am. Obs. 286–289. *Jan.* 16.—About 10 a.m. I took M. out hunting, but he was not at all keen; I found when he got back he was extremely thirsty and perhaps had fever.

Obs. 286. *Sp.* —.—He ate two large *Cyrtacanthacris* grasshoppers.

Obs. 287. *Sp.* 127.—Lymantrid: while M. was on a bush something fell off a branch on to the ground among long grass. M. jumped down to see what it was, and picked it up, handled it, and dropped it. It was a dark caterpillar with short grey hairs.

After this a number of insects were eaten.

Series An. Obs. 290–303. *Jan.* 16.—At noon I tried M. with the following. He should have been hungry, but was not.

Obs. 290. *Sp.* 129.—*Sternocera boucardi* Saund.: an enormous beetle, greyish or greenish ground-colour, spotted conspicuously with yellow pubescence, found in numbers on slender twigs of small tree—very conspicuous both at rest and on wing. M. looked at it for a long while, walked round it, then tried biting it, but could make no impression on its hard and slippery surface. In some way it nipped him (probably his tongue got nipped between posterior edge of thorax and anterior edge of elytra, as with Sp. 43, Obs. 70) and he put it down hurriedly and began to paw it on the ground. After a while he took heart and began again, and at last bit off its head, but spat it out uneaten. Eventually he got the viscera exposed, and ate the beetle in much doubt, rejecting some pieces—it was obviously very hard work breaking it up.

Obs. 292. *Sp.* 131.—Chrysomelid: a cluster of larvae found on end of a twig, inhabiting a common web. The larva was about ¼ in. long, hairy, fat, and dull pink in colour, with median and lateral darker pink longitudinal stripes. I put the branch on the ground; M. walked round and round looking at the larvae, then tasted one, but did not eat it, and would have no more to do with the others—actually backing away when I held out the branch towards him.

(*Note.*—In this case the distasteful larvae gain very greatly by massing themselves together—for an individual is not extremely conspicuous.)

Series Ao. Obs. 304–314. *Jan.* 16.—At 5 p.m. I took M. out hunting: he was keen.

Obs. 304. *Sp.* 21.—Histerid, *Hister validus*: I found and offered this shining black beetle to M., who would have nothing to do with it.

Obs. 305. *Sp.* —.—He then found and ate a large grasshopper (*Cyrtacanthacris*).

Obs. 306. *Sp.* 58.—Acridiid, *Tanita* sp.: M. found a pair of these small grasshoppers in copula. The ♀ is green with integument roughened by papillae: the short tegmina do not entirely cover the imperfect red wings. M. ate them both slowly and hesitatingly.

Obs. 307. *Sp.* 42.—Coreid, *Anoplocnemis curvipes:* M. found one of these bugs on a bush and ate it in his usual hasty manner.

Obs. 308. *Sp.* 34.—Acridiid, *Humbe tenuicornis:* M. saw this grasshopper on a bush from a long way off and chased it, but it escaped.

Obs. 309. *Sp.* 58.—Acridiid, *Tanita* sp.: another pair found in copula. M. went for the larger ♀ first, but this time he only bit off the head and dropped the rest, which was kept for record. He then began to eat the ♂, but mouthed it a good deal and rejected some parts.

Obs. 310. *Sp.* —.—He then ate a large *Cyrtacanthacris* grasshopper, and some leaves.

Series Ap. Obs. 315–317. *Jan.* 17.

Series Aq. Obs. 318–328. *Jan.* 17.—M. very hungry.

Obs. 319. *Sp.* 144. Mantid: I offered M. a half-grown specimen of a large species; leaf-green with some white marks on the sides of the fat abdomen. M. looked at these marks with a little doubt before devouring the mantis with zest.

(*Note.*—It is interesting that M. took particular notice of these white marks which, when the insect is seen away from its surroundings, seem conspicuous. Doubtless among grass-stems the white marks aid concealment by breaking up the large area of uniform green.)

Obs. 322. *Sp.* 147.—*Papilio leonidas:* a blue and black tailless "swallowtail," mimicking the Danaine *M. petiverana*. M. held it a long time in his hand and looked at it very thoroughly, then, having tasted it gingerly, ate it without any sign of dislike.

(*Note.*—Though I had never offered him the Danaine model and he probably had never seen it, his behaviour was suggestive of an instinctive hesitation to eat a butterfly of this scheme of colour.)

Obs. 327. *Sp.* 152. Mutillid: a small species. Offered in a box with the next one. To my surprise M. took out and ate the Mutillid.

Obs. 328. *Sp.* 153. Cetoniid, *Leucocelis haemorrhoidalis* F.: a small beetle with elytra shining green, thorax black with two bright orange patches. Though M. was hungry enough to brave the sting of the Mutillid, he would not touch this beetle, which is abundant and exposes itself freely on flowers.

Series Ar. *Obs.* 329–337. *Jan.* 17.—In the evening I took M. out hunting.

Obs. 334. *Sp.* 46.—Tenebrionid, *Vieta* sp. ? *vestita*: M. found this procryptic, but bristly, beetle on a tree-stem near the ground, and took it, but at once dropped it.

(*Note.*—This beetle is an interesting example of how a procryptic insect can yet have means of defence when discovered. The fine bristles on the elytra aid concealment by holding dirt. It will have been noticed that in this observation, as well as in 68, the monkey disliked the feel of the beetle.)

Series As. *Obs.* 338–342. *Jan.* 18.—About twenty larvae taken from the mud nest of a large solitary wasp were greedily eaten by M. (*Obs.* 342. *Sp.* 161) after he had refused a large dull-black larva with orange head (probably Phytophagous). This tends to show that the wasp is not intrinsically distasteful.

Series At. *Obs.* 343–362. *Jan.* 18.—After a day's march M. was eager for insects.

Obs. 347. *Sp.* 7.—Meloid, *Mylabris tristigma* Gerst.: M. was very excited as he saw me bring something in my hand, but when I opened my hand and he saw this typically aposematic beetle inside he walked away!

Obs. 356. *Sp.* 170.—Pierid, *Mylothris agathina* ♂: a yellowish-white butterfly showing the typical "mud drinker's aposeme," viz. an orange-yellow flush at the base of the hind-wing beneath, and an orange border along the under-side of the anterior edge of the fore-wing. The hind-wing is bordered with black spots. M. was very eager to get this butterfly, but when he got it, held it in his hand and looked at it for a long while, then tasted its head. He afterwards ate the butterfly slowly with a lot of tasting and inspection.

Obs. 362. *Sp.* 176. Locustid [Tettigoniid], *Gymnoproctus* sp., immature: an absolutely wingless grasshopper with stout body and spiny thorax, greyish with tint of green on thorax, a young specimen. It is by no means conspicuously coloured, but is of aposematic habit. An allied larger species (*Enyaliopsis*), much darker in colouring, is much disliked by the natives of Uganda, who say its bite makes sores. As a matter of fact, it readily exudes a yellowish acrid fluid.

I showed the *Gymnoproctus* to M. on my hand, but he would have nothing to do with it.

Series Au. *Obs.* 363. *Jan.* 21.

Obs. 363. *Sp.* 177.—Before M. had had anything to eat in the early morning I offered this Carabid, a species of *Tefflus*, a large dull-black ground-beetle. M. merely danced round it and would not touch it except to paw at it.

Series Av. *Obs.* 364–369. *Jan.* 21.—I took M. out hunting in the afternoon.

Obs. 364. *Sp.* 22.—Acridiid, *Dictyophorus productus*, Bol.: having eaten a lot of grass M. picked up this immature medium-sized grasshopper, almost wingless, with only rudiments of elytra, light yellow with longitudinal black stripes, typically aposematic, of very sluggish habits. He put it down undamaged.

Obs. 368. *Sp.* 179.—Scoliid, *Elis donaldsoni* Fox: to my great astonishment M., in front of a flowering bush, reached out and seized this Fossorial wasp, dull black with tip of abdomen dull red. M. ate it quickly.

Series Aw. *Obs.* 370–386. *Jan.* 21.

Obs. 384. *Sp.* 185. Lymantrid: the pupa of a very abundant white moth. It is shiny and bright yellow and clearly visible in the flimsiest of cocoons. The eyes and spiracles are shining black and very conspicuous; the sparse hairs rather long. I offered the cocoon to M., who ran away with it to examine it further. But it dropped as he went along (*N.B.:* desirable food would not be allowed to drop), and instead of picking it up, M. rubbed it very vigorously on the ground, as if it might bite or sting, and ate it very doubtfully.

Series Ax. *Obs.* 387–405. *Jan.* 23.—At 9 a.m., M. having had no insect food, but some banana—

Obs. 394. *Sp.* 153. Cetoniid, *Leucocelis haemorrhoidalis:* M. smelt this beetle, put it down with an exclamation of disgust and walked away. The beetle emits a drop of foul-smelling fluid when handled.

Series Ay. *Obs.* 406–414. *Jan.* 23.

Series Az. *Obs.* 415–451. *Jan.* 24.—At 2 p.m. M. had had food but no insects, and squealed with excitement when he saw them coming.

Obs. 415. *Sp.* 117.—Carabid, *Harpalus* sp.: M. ate this black ground-beetle, *but rubbed his hands on the ground afterwards.*

(*Note.*—This very significant gesture shows how very distasteful was this beetle, which was only eaten under stress of hunger.)

Obs. 416. *Sp.* 86.—Lycid, *Chlamydolycus trabeatus*: this was actually tasted, but no more.

Obs. 417. *Sp.* 198. Lycid, *Merolycus femoralis*, Bourg.: M. pulled this beetle to pieces, tasted it, but ate none.

Obs. 418. *Sp.* 196.—Galerucid, *Diacantha* sp. nr. *conifera*: a bright yellow beetle with black tips to the elytra. This beetle was taken and dropped.

Obs. 419. *Sp.* 199.—Silphid, *Silpha micans* F.: a sea-green beetle found on an old giraffe skull. It was put on the ground and allowed to crawl within reach of M., who took it, bit it, and very decidedly put it down.

(*Note.*—That M. should bite such a very foul beetle shows how desirous he was for insect food, and makes his behaviour in *Obs.* 416–418 more emphatic. Later in this series, when he had eaten some insects, he refused a second *Silpha* with an exclamation of disgust!)

Obs. 420. *Sp.* 200.—Fulgorid, *Pyrops marginatus* Westw.: about an inch long, with a long snout, grey and speckled. I put it on the ground for M., who picked it up and bit off the "snout." Not finding it distasteful he put the whole insect into his mouth, but soon took it out, looked at it, pulled it about, and dropped it.

(*Note.*—This extremely procryptic insect was apparently quite distasteful.)

Obs. 421. *Sp.* 201.—Forficulid, *Forficula senegalensis* Serv.: an abundant medium-sized brown earwig with yellow tegmina. M. rubbed it very vigorously on the ground and would not taste it.

Obs. 422. *Sp.* 188. Eumolpid, *Euryope batesi*

Jac., ♀: a large, sluggish, bright orange beetle with black eyes and antennae. M. bit off the elytra, tasted the beetle, put it in his mouth, ejected it with an expression of disgust, but put it back and ate it reluctantly.

Obs. 447. *Sp.* 215.—Tenebrionid, *Catamerus revoili* Fairm.: a large, common, dull blue-black, sluggish beetle, much reminding one of the English "bloody-nose beetle," save that its elytra are rugose: it walks about like the other, and is as conspicuous. M. looked at it for a long while, took it and smelt it, and rubbed it furiously on the ground. I went to pick it up, but M., out of mischief, seized it and held it, but even then did not put it in his mouth.

(*Note.*—Between *Obs.* 422–447 M. had eaten a number of insects.)

Series Ba. *Obs.* 452–454. *Jan.* 25.

Series Bb. *Obs.* 455–470. *Jan.* 26.—At 7 a.m., M. having had as much vegetable food as he wanted—

Obs. 455. *Sp.* 218. Lycid, *Merolycus dentipes* Dalm., var. *flavoscapularis* Bourg.: typically aposematic, orange and black beetle. M. turned it over, pawed, smelt, and left it.

Obs. 456. *Sp.* 188. Eumolpid, *Euryope batesi*: M. would have liked to eat it, but couldn't face it: he licked and smelt it and finally dropped it.

Obs. 457. *Sp.* 54.—Galerucid, *Diacantha conifera*: pinkish-orange beetle with the end of the abdomen projecting beyond the black tips of the elytra. Several males and females found most conspicuously on low herbage. One was offered to M., who smelt it and threw it down.

Obs. 458. *Sp.* 220.—Tenebrionid, *Zophosis pterygomalis* Gebien: a flat, dull grey-black beetle, which runs about in hot sun very actively. Many were found under a stone. One was put on the ground for M., who smelt it, nibbled at it, pulled it to pieces, and put it down uneaten.

Series Bb. *Jan.* 26.

Obs. 459. *Sp.* 197.—Sagrid, *Sagra* sp., not in Br. Mus.: a large, dull blue-black beetle of sluggish habits; the hind femora are greatly thickened. M. looked at this beetle for a long while, not really wanting it, but being playful and mischievous, took it in his hand and ran about with it. He then nibbled a leg off, looked again at the beetle, tasted it again, and finally put it in his mouth and ate it because another monkey, near by, wanted to see what he had got! I am quite sure he would not have eaten it had he been alone.

(*Note.*—It was remarked at the beginning of the paper how important it was to know the monkey, and that he should be undisturbed. An inexperienced observer might easily have concluded that the above beetle was far more edible than another observation (413) has shown it to be.)

Obs. 460. *Sp.* 221.—Curculionid, *Microcerus spiniger* Gerst.: a ground-weevil, large, black, with rugose elytra and short blunt rostrum. M. looked at it a long while before taking it; ran about with it as if challenging the other monkey to take it, then bit off the rostrum and ate the beetle with difficulty. It seemed very hard and M.'s attitude suggested that he was only eating it to spite the other monkey!

Obs. 461. *Sp.* 22.—Acridiid, *Dictyophorus productus:* M. looked long at this grasshopper as it crawled on the ground, then picked it up and ran about with it in play, then dropped it.

Obs. 462. *Sp.* 186.—*Five* of these Acridians (*Catantops decoratus* Gerst.) eaten eagerly. A medium-sized, procryptic, grey grasshopper used as staple food.

Obs. 463. *Sp.* 222.—Pyrrhocorid, *Roscius illustris* Gerst.: a large black bug, with red head, an orange spot on each side of the thorax, and two orange spots on each tegmen. Extremely conspicuous. M. looked at it, smelt it, bit off and ate its head, then ate the rest without definite sign of pleasure or dislike.

Obs. 464. *Sp.* 223.—*Bromophila caffra* Macq.: a very large and sluggish black fly with crimson head, extremely conspicuous at rest, or when flying, which it does slowly and heavily, being remarkably easy to catch. Any human would say, "What a disgusting-looking fly!" It was offered to M. in a box; he looked long at it, with his head on one side, took it out, and threw it down in disgust.

Obs. 465. *Sp.* 224.—Buprestid, *Agelia peteli* Gory: a large black beetle, with symmetrical pale greenish-white areas on the elytra and an orange mark on each side of the thorax. A pair, in copula, found sitting conspicuously exposed, on a leaf of a bush. One was offered to M., who took and ate it without hesitation.

Obs. 466. *Sp.* 186.—*Catantops decoratus :* three staple grasshoppers eaten readily.

Obs. 467. *Sp.* 225.—Tenebrionid, *Rhytinota acuticollis* Fairm. : like 69 (Obs. 133), a smooth, black, polished beetle. Found under a stone, but others often seen running conspicuously in the sun. M. paid no attention to it crawling in front of him till I pushed it towards him, when he bit it in half, and hurriedly spat out the piece in his mouth.

Obs. 468. *Sp.* 226.—Lamiid beetle, of fair size, dull blue-black, spotted with buff, procryptic. Offered to M. on my fingers; he seemed to know the beetle from some distance away, ran up and seized it at once. He bit off its head, and ate it, then looked attentively at the body before eating it all.

Obs. 469. *Sp.* 186.—*Catantops decoratus :* three grasshoppers eaten, but not very hungrily.

Obs. 470. *Sp.* 227.—Blattid : a male cockroach of the usual light brown colour, was given M. in the afternoon. After a little hesitation he bit off its head, but did not seem to like it much, he merely pulled the body about and played with it.

Series Bc. *Obs.* 471–484. *Jan.* 27.—At 10 a.m. M. had had as much vegetable food as he wanted, but squealed with excitement when he saw me bring the insect boxes. So I gave distasteful species first—

Obs. 471. *Sp.* 215.—Tenebrionid, *Catamerus revoili :* M. looked long at it, turned away, looked again, picked it up and bit it. A droplet of yellow oily fluid came out from between thorax and abdomen, and M. at once dropped the beetle.

Obs. 472. *Sp.* 13.—Tenebrionid, *Macropoda transversalis :* when I put this beetle down, M. looked disappointedly at it for some time, then took it and ran about with it in play, put it in his mouth, crunched it a little, then took it out and put it down.

Obs. 473. *Sp.* 228.—Coreid, *Cletus ochraceus* H. S. : a small, brown, plant-feeding bug, procryptic. Put in mouth and rapidly eaten with face rather doubtful and expressive of dislike.

Obs. 474. *Sp.* 229.—Carabid: a small, black ground-beetle; several found together under a stone. M. rubbed it violently on the ground, picked it up, bit off its head, looked at it surprisedly, pulled it to pieces, smelt and tasted it, but ate none.

Obs. 475. *Sp.* 230.—Blattid, ♀: this cockroach, medium-sized, light brown, was found lying in the paralysed condition caused by a sting from a Fossor. Offered to M., who rubbed it on the ground, smelt it, pulled it to pieces, but ate none.

Obs. 476. *Sp.* 231.—Trogid, *Trox incultus* Boh.: a scavenging beetle, very sluggish, dull grey-black, with rugose elytra. When alarmed it tucks all its limbs close to its body, and looks like half a raisin! It is found under dried-up bits of hide, bones, stones, etc. I offered one to M., who very minutely examined it, pulled off a leg and tasted it, then nibbled and pulled it to pieces, but ate none.

Obs. 477. *Sp.* 232.—Blattid, ♀: a black cockroach, offered in a box; M. took it out, pulled it about, smelt it, and allowed it to run away.

Obs. 478. *Sp.* 233.—Melolonthid, *Schizonycha* sp.: a medium-sized, light brown chafer which came to light. M. pulled it about, and ate it very doubtfully.

Obs. 479. *Sp.* 117.—Carabid, *Harpalus* sp.: this beetle was violently rubbed on the ground, and then crunched up very quickly, seemingly less disliked than was No. 229 (Obs. 474), though obviously eaten only owing to hunger.

Obs. 480. *Sp.* 186.—Eight staple Acridians (*Catantops*) were then greedily eaten, with squeals of excitement.

Obs. 481. *Sp.* 93.—Nymphaline, *Precis cebrene:* this butterfly was eaten eagerly. M. then had a long drink.

Obs. 482. *Sp.* 234.—Zygaenid, *Neurosymploca xanthosoma* Jord.: a small moth, of uniform dull greenish-black colour, offered in a box. M. took it out, smelt it, pulled it into many pieces; tasted it, but ate none.

Obs. 483. *Sp.* 186.—One *Catantops* eagerly taken.

Obs. 484. *Sp.* 235.—Carabid, *Eccoptoptera cupricollis* Chaud.: a medium-sized ground-beetle, mimicking the general type of colouring of a *Mutilla*, like which also it ran. The head and thorax are dull red, the pubescent elytra dull black with four large white spots. I allowed this mimetic beetle to run within reach of M., who appeared afraid of it, pawed it, and at once ran out of reach; this he did several times, and at last ate it very quickly with no sign of dislike.

(*Note.*—In a way this was disappointing, as I had hoped M. would leave it alone. Nevertheless he has eaten Mutillids on other occasions. The manner in which he ran out of reach after delivering his attack suggested very strongly that he was afraid of a sting from the Mutilloid insect; for although a Carabid of similar size would be pawed, M. would not run away from it. Moreover, had M. thought it was a Carabid beetle I believe he would *not* have eaten it at the end of a long experiment when he had had abundance of insect food. A point of considerable interest is that this mimetic beetle seems to have lost the extremely unpleasant acrid smell emitted by most members of its family—it could not be made to produce it by repeated interference, or even by pressing it down on to a hard surface. One is tempted to conclude that in the absence of its defensive weapon it has come to resemble the powerfully stinging aposematic *Mutilla.* Even the *Mutilla,* however, is tackled on occasion, and eaten by M. !)

Series Bd. Obs. 485–503. *Jan.* 27.—At 4 p.m., M. being ready for insects—

Obs. 493. *Sp.* 239.—Fulgorid, *Hypselometopum morosum* Westw.: a fairly large Homopterous species kicked up from low herbage; the tegmina speckled brown, very procryptic. The wings were tinted with rose, the abdomen whitish, waxy. I held it in my fingers so that the rosy wings could be seen. M. took it and looked at it for a very long time, pulled off one tegmen, put the insect into his mouth and closed his lips over it without biting it, pulled it out again, looked at it, pulled off the other tegmen and both wings, looked long at the waxy abdomen, and at length ate it very doubtfully.

Obs. 499. *Sp.* 244.—Cerambycid, *Anubis* (*Oligosmerus*) *limbalis* Har.: a small, slender, bright green Longicorn beetle with the long black antennae tightly curled back at the tips. Like our "musk-beetle," it has a strongly aromatic, rather pleasing odour. I have only seen the beetle feeding on the yellow flower-heads of a common Composite, where it is, of course, conspicuous, but among green foliage it might be concealed. When it was offered to M. he did not eat it at once, but took it and ran up to his perch, where he had a good look at it, then ate it with no sign of dislike.

Series Be. *Obs.* 504–510. *Jan.* 27.—I took M. out hunting, but he was not keen.

Obs. 510. *Sp.* 172.—Pierid, *Belenois mesentina:* as M. walked along he saw this white butterfly in the position of complete repose on a grass stem. He ran to it, pounced on it with both hands, and ate it with gusto.

(*Note.*—His manner of catching the butterfly strongly suggested an instinctive method of catching insects commonly eaten. He does not catch grasshoppers like that.)

Series Bf. *Obs.* 511–529. *Jan.* 28.—At 5 p.m. M. very hungry for insects, though he had had plenty of vegetable food.

Obs. 516. *Sp.* 250.—Tenebrionid, *Anchophthalmus clathratus* Gerst.: a dead black, flat beetle found under a log. I put it down for M., who looked at it and twice bent down to nibble it, drawing back each time with a little shake of his head as if it had bitten him, after which he left it alone. I found that this beetle stridulates by vigorous nodding movements, the "neck" rubbing against the thorax.

Obs. 529. *Sp.* 257.—Mutillid, *Dolichomutilla guineensis* F.: a large black species with two white spots at base of abdomen and two at apex. M. with great eagerness seized it out of the box and bundled it into his mouth, getting his hands and lips stung. He shook his head and ran about, and the Mutillid fell out of his mouth, but he picked it up and ate it greedily, though for a few minutes afterwards he ran about shaking his head and wiping his mouth with his paws.

(*Note.*—M. must have been very hungry, for after eating 14 grasshoppers and 5 other insects, and having been badly stung, he picked up the *Mutilla* again and ate it. I had no more insects left to test him with.)

Series Bg. *Obs.* 530–546. *Jan.* 29.—At 2 p.m., M. having had a good meal of vegetable food but no insects—

Obs. 533. *Sp.* 59.—Lagriid, *Lagria rhodesiana* Péring., a dull purplish, hairy, soft beetle that freely exposes itself on grass tips. I kept this in my closed hand, so that M. was inquisitive to see what was inside. When I opened my fist and he saw the very distasteful beetle his face fell and he would not touch it. But he took it as a joke, broke into a broad grin, and frolicked with my hand in a most amusing way.

Obs. 539. *Sp.* 260.—Buprestid, *Discoderes* sp., not in Br. Mus.: a highly procryptic beetle, of rather curious appearance, about half an inch long. Brown, with curious little knobs and excrescences. I found a pair in copula on a leaf, and did not recognise them as beetles at first; nor, apparently, did M. I offered one on my hand; M. looked at it and after a little hesitation took it, looked again at it, and put it in his mouth for a preliminary bite. This, however, made no impression on the hard beetle, and M. took it out for another look. After several more gentle bites had no effect M. bit harder, and finding it tasty, ate it with relish.

(*Note.*—It seems extremely likely that M. would have altogether passed the beetle by in its natural surroundings, owing to its procrypsis.)

Obs. 540. *Sp.* 261.—Curculionid, *Baris* sp.: a small long-snouted black weevil. M. ate it at once without hesitation.

Obs. 541. *Sp.* 262.—Zygaenid, *Neurosymploca xanthosoma* Jord.: a small dull black moth with bright yellow abdomen and a yellow spot on each side of the thorax. Very sluggish, and sits about on grass stems. A ♂ was offered to M., who pulled it to pieces, and put the yellow abdomen into his mouth, rolled it about and mouthed it a lot, but did not eat it with pleasure.

Obs. 542. *Sp.* 263.—Lamiid, *Spilotragus xanthus* Jord.: a small and delicately made Longicorn beetle, light grey and yellow. M. handled it gingerly and examined it well, bit off its head delicately, and ate the rest rather doubtfully.

(*Note.*—It seemed to me that the yellow markings in a slight degree gave this slender beetle a Hymenopterous appearance, and from the careful way M. handled it at first, I think he was of the same opinion.)

Obs. 543. *Sp.* 262.—Zygaenid, *Neurosymploca xanthosoma:* M. pulled the wings off this moth, put the abdomen in his mouth, rolled it about, and pulled it out again.

Obs. 544. *Sp.* 264.—Pierid, *Eronia cleodora:* a large white butterfly with broad, irregular, black border; on the under-surface the wings in position of complete rest extraordinarily resemble a yellowish half-dead leaf. *At rest*, therefore, this butterfly is extremely procryptic, and I expected it to be eagerly eaten. I offered one to M., holding it gently by the body in my fingers, so that he could see it well. He leapt up and seized it, but instead of putting it straight into his mouth he sat looking at it for a long while, tasted it, pulled it about, and ate parts of it only, with doubt and much "mouthing."

(*Note.*—This butterfly makes the most of its procryptic under-surface by selecting for its sleeping-place some leaf, half dead, of the yellowish-green variegated colour with which the under-surface of the wings so well harmonises. In one locality where I collected the butterfly was not at all abundant, yet one evening, when passing a tall herb which had only a few big leaves, one of which was wilted, no less than three *E. cleodora* suddenly flew out, to my amazement, as I had no idea they were there. I watched one deliberately return and hang from the under-side of the wilted leaf, with which its colours so well harmonised. ("Essays on Evolution," pp. 283, 301.)

The fact that such an undoubtedly procryptic underside is not associated with a greater degree of edibility is interesting. Seeing that this butterfly is so unusually procryptic, and that its close ally *Catopsilia,* Obs. 360 and 577, Sp. 174, is shown to be also somewhat distasteful, that quality is perhaps associated with the particular group to which *cleodora* belongs, and it may be an exception among its relations in being markedly procryptic.)

Obs. 545. *Sp.* 212.—*Teracolus eris* Klug.: M. seized this Pierine butterfly quickly, and ate it, but not with great relish. A white species with broad black bar on f.w. and a bistre patch at the tip.

Obs. 546. *Sp.* 186.—Five staple Acridians (*Catantops decoratus*) eaten with zest.

Series Bh. *Obs.* 547–548. *Jan.* 29.

Series Bi. *Obs.* 549–563. *Feb.* 1.

Series Bj. *Obs.* 564–581. *Feb.* 2.—At 2 p.m., M. having had food, but no insects—

Obs. 570. *Sp.* 47.—Buprestid, *Agrilus discolor:* a pair of these beetles found in copula conspicuously exposed on a leaf. One was offered to M., who looked so long at it that I thought he was not going to take it. Suddenly, with decision, he took and bit it, and then ate it without further hesitation.

(*Note.*—The grey, black, and rose tints of this beetle and their arrangement somewhat remind one of the similar colours common among Hemiptera; and M.'s behaviour rather suggested that there may be a deceptive resemblance. If so, the mimicry is pseudaposematic, for the beetle was very edible.)

Series Bk. *Obs.* 582–586. *Feb.* 3.—At 2 p.m., having had some food, M. eager for insects. He refused a Cetoniid (*Diplognatha silicia*) and then ate 15 grasshoppers.

Obs. 585. *Sp.* 278.—Chrysidid: a medium-sized "fire-tail wasp" of the usual brilliant green, with blue tip to the abdomen. M. looked long at this, then took it and ate it, to my great surprise not getting stung.

(*Note.*—It is very likely that M. had not met one of these before—it will be noted that he looked at it a long time. These formidable, stinging insects are hard and highly conspicuous.)

Obs. 586. *Sp.* 279.—Galerucid, *Exosoma ugandaensis* Jac.: a small, gregarious, conspicuous beetle found on low herbage; head and thorax black, abdomen brown. It was smelt and dropped; I offered it again, with the same result.

Series Bl. *Obs.* 587–595. *Feb.* 4.—In afternoon, M. being eager for insects—

Obs. 590. *Sp.* 280.—Cassidid: a large "tortoise-beetle," fiery orange-pink spotted with black, and translucent. Very conspicuous on the wing. M. ignored it at first, then took and dropped it. Then, because I wanted to take it for record, M. ran off with it and pulled it to pieces, but ate none.

Series Bm. Obs. 596–611. *Feb.* 5.—At 1.30 p.m., M. had had food, but was very hungry for insects.

He ate 12 grasshoppers and some other insects, refusing others.

Obs. 606. *Sp.* 286 A.—*Danaida chrysippus:* the typically aposematic orange-brown butterfly with black wing tip enclosing a white bar. M. seized it very eagerly, then looked at it for a long time, pulled off the wings, and ate the body.

Obs. 607. *Sp.* 287.—Hypsid, *Argina amanda* Bd.: a medium-sized, bright orange moth speckled with black. The wings of one side were cut off and the moth put on the ground. M. looked well at this, put the body into his mouth, pulled it out, put it in and pulled it out again, and finally discarded it.

(*Note.*—His refusal of this aposematic moth is made more emphatic by his having been hungry enough to eat the distasteful *D. chrysippus.*)

Obs. 608. *Sp.* 170.—Pierid, *Mylothris agathina:* M. was not at all eager to take this butterfly from my fingers, but ate it without definite sign of dislike.

Obs. 609. *Sp.* 286 B.—*Danaida chrysippus,* form *dorippus* Klug: the variety without black-and-white wing tips. M. took it and pulled off the wings, then ran about with the body for some time before putting it into his mouth and eating it. After this two medium-sized and one large grasshopper were eaten.

Series Bn. Obs. 612–615. *Feb.* 5.—These were the last observations made with M., for his owner took him back.

SECTION II.

In this section an attempt will be made to diagnose the degree of edibility of each species used in the experiments (including those of which details are omitted), grouping the species in their proper genera and families.

I propose to use letters to denote the significance of the colours and habits of the insects, and the signs +, —, or ± to denote their edibility.

It must be constantly borne in mind here that I am only speaking of edibility *to the monkey which was used as the test:* to another animal, or a bird, the insects might be more, or less, edible.

Regarding the colours, they may be either aposematic, or procryptic, or of such a nature that one cannot class them in either category.

One had also to consider that there are insects which, from freely exposing themselves, appear to have what may be termed "aposematic habits," although such habits may not be associated with conspicuous colours.

Likewise there are insects whose colours do not seem especially to harmonise with their surroundings, yet their habits are like those of typically procryptic insects.

AA	In this class I put the typically aposematic insects of bold and fearless manner, showing conspicuous colours freely exposed.
A	Comprises the less conspicuous, but still conspicuous and exposed species.
a	In this class are the insects which have aposematic habits, although their colouring does not make them conspicuous.
PP	These are the typically procryptic insects, concealed by their extreme degree of resemblance to the colours, and often shape, of their immediate surroundings. Attitude often plays an important part in increasing the resemblance.
P	Insects of self-effacing habits, concealed on the whole by dingy colours or a general resemblance to their surroundings.
p	This class contains insects of retiring nature, whose colours cannot be said particularly to aid in their concealment.
C	This letter implies that I do not see my way to putting the insect in any of the other groups, *i.e.* it is a confession of ignorance !

Regarding the edibility, I have made six categories.

++	This is the class of extremely edible species always eaten greedily, without hesitation, and with evidence of relish.
+	These insects are eaten with relish, but are first looked at for some time, or may be tasted.
±	In this class come those species which are eaten doubtfully, or may be refused, after tasting, smelling, or pulling about. It must be remembered that this implies a certain degree of distastefulness.

The qualifications for this class are that the insect undergoes repeated tasting, smelling, pulling about; may be pulled to pieces and examined and only eaten partially, or the whole may be put into the mouth and pulled out again. These insects are only eaten extremely doubtfully, or because of hunger.

— — In this class are put insects which are only tasted, and eaten with great reluctance only under pressure of great hunger.

— — — These insects are never even tasted, and may be completely ignored.

○ This sign is used to surround any of the other signs, thus, ⊕ or ≡⃝. It implies that, on one occasion at least, the monkey has rubbed and pawed the insect on the ground as previously described in the introduction, and has subsequently dealt with it as indicated by the sign enclosed in the circle.

It will be noticed that if an insect escapes tasting it must be either highly edible, or highly distasteful!

ORTHOPTERA.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Forficulidae.			
201	421	*Forficula senegalensis* Serv.	C	≡⃝	Abundant, medium-sized, brown and yellow.
208	439, 550	*Anisolabis infelix* Burr.	C	≡⃝	Large, apterous, black.

General remarks on the FORFICULIDAE.

M. showed extreme dislike of, and I think fear of, these earwigs. I could detect no odour and concluded that the appearance of the forceps acted as deterrent. If earwigs were liked they would be a very easily obtained food, for they are usually abundant when present.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Blattidae.			
79	161	?	C	++	There is doubt as to whether this *was* a Blattid.
126	285	?	C	— — —	A light yellow male.
227	470	?	C	— — —	A light brown male.
230	475	?	C	⊜	A light brown female.
232	477	Prob. a *Pseudoderopeltis* sp.	C	— — —	A black female.
266	549	?	C	— —	A-large, black female.
270	565	Larva	C	— — —	Small, yellow-brown.

General remarks on the BLATTIDAE.

This monkey seemed to agree with the human estimate of cockroaches as disgusting insects! Obs. 161 is unique, and one is almost forced to believe it was *not* a cockroach that the monkey ate so eagerly. The notes omitted show that I did not see the insect until it was nearly consumed. The colours of the above Blattids do not fall into the scheme of classification adopted. The brightest-coloured light yellow species are just as timorous and light-shy as the darker species.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Mantidae.			
19	26, 92, 95, 165, 194, 243	*Idolum diabolicum* Saus.	PP	++	Large, green, with leaf-like expansions.
33	43	?	O	++	Very young, black, ant-like.
57	112	?	PP	++	Young, grey.
71	140	?	PP	++	Young of large species, slender, stick-like.
82	170, 173, 187, 247, 274	?	PP	++	Half-grown, brown.
128	288	?	PP	++	Small, brown species.
138	312	?	PP	++	,, ,, ,,
139	313	?	PP	++	Large, green species.
144	319		PP	+	Half-grown young of large species.

General remarks on the MANTIDAE.

All the above were extremely procryptic except the very young, No. 33; these small black specimens were somewhat ant-like. But when they are too large for this resemblance, Mantidae, so far as I am aware, are the most generally cryptic of any family of insects, and, young and old, were eaten with greed. Also the large and conspicuous white egg-capsules of No. 19 were eaten and sought out greedily. (See Series O, P, Q, X, Ab, Ac, Af, Ak.) Many Mantidae are known to take up a defensive or "terrifying" attitude when threatened, accompanied with a noise produced in a special way, and I was able to see this adopted on several occasions by No. 19, and on the first occasion it seemed to cause the monkey to leave the mantis alone. (See Obs. 26, 95, 194.)

		Phasmidae.			
81	168, 238, 278, 281	?	PP	++	

The *Stick* insects, most procryptic, were greedily eaten by M., as might be expected. It is noteworthy that on one occasion (Obs. 168) he seemed in some doubt as to whether a specimen *was* a living insect.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Acridiidae.			
5	7, 49, 217	*Zonocerus elegans* Thunb.	AA	– – –	Large, conspicuous, clumsy, black when young, when adult yellow and green with undeveloped wings.
16	23, 27, 160, 273, 308	*Phymateus viridipes* Stål.	AA	– – –	Large, conspicuous, sluggish, blue, green and red, flies heavily showing purple wings.
17	24	*Tryxalid.*	PP	+ +	Large, green.
35	45	,,	PP	+ +	Large, green and brown; shows mauve wings when flying.
18	25, etc.	*Cyrtacanthacris ruficornis* Burm.	PP	+ +	Brownish, with grey and yellow marks. Used as staple food. No. 23 much larger, has purple wings.
23	33, etc.	*Cyrtacanthacris cyanea* Stoll.	PP	+ +	
22	32, 116, 186, 364, 461, 490, 532	*Dictyophorus productus* Bol.	AA	– –	Heavy-bodied, sluggish, aposematic, light yellow striped with black when younger, adults dark grey with undeveloped red wings.
34	44, 308, 345	*Humbe tenuicornis* Schaum.	PP	+ +	Earth-brown; yellow wings bordered with black.
58	113, 210, 272, 306, 309	*Tanita* sp., not in Br. Mus., and *T. semlikiana* Rehn.	PP	±	Small, earth-coloured; wings red.
91	193, 592	*Lamarckiana loboscelis* Schaum.	P	±	Huge, apterous, earth-coloured female.
155	335	*Cardenius* sp., not in Br. Mus.	A	–	Short, stout, dull pinkish-brown, sides of abdomen red spotted.
186	387, etc.	*Catantops decoratus* Gerst., and *melanostictus* Schaum.	P	+ +	Used as staple food. Brown marked with yellow, black and greyish tints, very abundant among grass.
214	446	*Penichrotes* sp., ♀	A	±	Wingless, green with purplish - black abdominal bands. Rather "unpleasant looking." Found on tree.
	5	?	PP	+ +	
	8	?	P	+ +	
	13	?	P	+ +	
	17	?	P	+ +	
	50	?	PP	+ +	
	63	?	PP	+ +	
	71	?	P	+ +	
	91	?	P	+ +	
	107	?	PP	+ +	
	108	?	PP	+ +	
	110	?	PP	+ +	
	131	?	P	+ +	
	138	?	P	+ +	
	148	?	P	+ +	

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
	149	?	P	++	
	211	?	P	++	
	227	?	P	++	
	263	?	PP	++	
	264	?	P	++	
	276	?	P	++	
	279	?	P	++	
	296	?	P	++	
	330	?	P	++	
	346	?	P	++	
	351	?	P	++	
	366	?	P	—	No reason discoverable for this rejection.
	371	?	P	+	
	377	?	P	++	
	381	?	P	++	
	385	?	P	++	
	488	?	PP	++	
	507	?	P	++	
	523	?	PP	++	
	554	?	P	++	
	611	?	P	++	

General remarks on the ACRIDIIDAE.

The species of monkey used for these experiments eats great numbers of Acridiidae; I have often seen them hunting through long grass in the evenings, catching the grasshoppers which rose in front of them.

Three, or four, species (18, 23, 186) were used as "staple food," and many others were given to M. solely to eke out the less edible insects. It was not at first intended to list these, but I have done so; and as no particular note was taken of them they have not been given species numbers.

Seeing that the Acridiidae were with few exceptions procryptic, the more interest attaches to those that are not, viz. 5, 16, 22, 155, 214.

It is noteworthy that in these five species the wings are absent or undeveloped, or when present are brightly coloured and very materially aid in the aposematic effect: in the case of No. 16 the insect especially displays them when alarmed (Obs. 160). In 1915 I saw precisely the same use made of the wings by the same species when threatened by a fowl. The fowl ran up to the grasshopper, which remained apparently unconcerned until the fowl was close, when it raised the tegmina and wings vertically, spreading out the latter to show the brilliant tints. The fowl halted, gazed at the grasshopper, turned round and walked away. Another day a specimen was killed and laid on the ground, the coloured wings being concealed in the position of rest. Fowls pecked at it but obviously found it very tough, and though they pulled it about ate none of it.

In January 1919 I had another young monkey, probably of the same species as M., and offered it one day several Acridiidae. She seized two specimens of medium size, one in each hand, and bit off their heads. But the first one did not seem altogether pleasant to the taste, and she did not eat it; *its wings were tinted with carmine.* Before eating the second specimen she pulled apart the wing-covers and displayed its wings. In this species they were colourless, and the whole was eaten (cp. Obs. 272). Next day I gave her first of all another of the carmine-winged species. She took it rather hesitatingly, although she hadn't seen its wings, did not bite off its head but rather slowly bit off one leg, munched it, and then dropped the grasshopper.

Two other, larger, very favourite Acridiidae were then offered; one she let escape, the other, as I persuaded her, was at length taken and its head bitten off. It was eaten slowly at first, but with increasing satisfaction, for obviously she distrusted it at first after the experience of the carmine-winged specimen.

This question brings us to the coloration of the wings in other species which were not found to be distasteful, noted in Obs. 33, 44, 45, 113. The meaning has already been discussed in the note on Obs. 272; I believe that the interpretation of these cases is that the very obviously coloured wings serve to attract attention when the insect flies, and when it very suddenly drops the eye fixes the point where the colour was last seen.

But the insect is *not there*, having always crawled away to hide, when its procryptic tegmina cover the bright wings.

These coloured wings, however, may form a starting-point for the development of an aposematic scheme of colour as shown in species No. 16, which was found to use them aposematically in Obs. 160; and species No. 58 appears to be in a transitional stage. For though this species is procryptic, its wings appeared to be taken as an aposeme by the monkey, who certainly found the grasshopper somewhat distasteful (cp. also the 1919 observation).

It would appear that it is an advantage to the definitely aposematic species to lose the wings; in only two did they function as organs of flight (16 and 155).

A very interesting species is No. 91; a huge procryptic absolutely apterous female, which has been discussed in the note under Obs. 193. It appears to be slightly distasteful and its colour scheme is such that a mere change of shade, not pattern, might make it definitely aposematic.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Locustidae (Tettigoniidae).			
176	362, 408	*Gymnoproctus* sp.	P	⊜	Absolutely wingless with spiny thorax, grey-green, very stout-bodied and sluggish, immature.
203	427, 429, 557	*Pantolepta heteromorpha* Karsch.	PP	±	Leaf-green, wingless, immature.
267	556	*Poecilogramma* sp.	A	— —	Blue-green with yellow markings, aposematic, apterous, immature ♀.
	265	?	PP	++	
	487	?	PP	±	(possibly same as 203.)
	537	?	PP	±	
	372	?	PP	+	Leaf-green.
	449	?	PP	++	,, ,,
	450	?	PP	++	,, ,,

General notes on the LOCUSTIDAE (TETTIGONIIDAE).

All of the above species were of the type with short fat bodies, all save one (176) of small size. Except for 176 and 267 they were bright green and extremely procryptic, but M. sometimes did not appear to eat them with much relish. In some cases the adult female is apterous.

It is of interest that another type of Locustid with long slender bodies, also green and sometimes brown, very procryptic, was always found extremely edible by my monkey on L. Victoria, who would eat them until his overfilled stomach rejected them! One specimen was identified as *Conocephaloides mandibularis* Charp. These Locustids are known to the Baganda as "Senene" and are esteemed by them as food. They often appear suddenly in long grass in large numbers.

		Gryllidae.			
248	504	*Gryllus* sp.	C	—	A large, black female.

This cricket, found by M., was half eaten, and discarded. Though monkeys may sometimes meet with crickets among dead leaves, etc., yet their nocturnal and burrowing habits render it unlikely that they serve as food to any extent.

NEUROPTERA.

		Termitidae.			
92	198, 267	?	C	+	A species which comes out of its holes in the ground and runs about even in the sun. It makes no hills.
		Hemerobiidae.			
213	445, 450	*Hagenomyia tristis* Walk.	C	±	

This Myrmeleonid had a smell somewhat like that of our lace-wing fly, and rather to my surprise it was eaten.

HYMENOPTERA.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Braconidae.			
245	500	?	AA	+	These three "Ichneumon-flies" were all typically aposematic, but were readily eaten one after another. Further experiments are needed.
246	501	?	AA	+	
247	502	?	AA	+	
		Apidae.			
125	284	*Apis mellifica* L., var. *adansoni* Latr.	A	⊜	Both these stinging insects were rubbed on the ground.
		Vespidae.			
124	282	*Rhynchium* sp., unnamed in Br. Mus.	AA	⊜	
		Formicidae.			
53	100, 249	*Megaponera foetens* F.	AA	− − −	M.'s fear of these powerfully stinging, large, black ants is shown by his leaping across a column on the march.
109	229	?	C	+ +	The winged adults of a small black ant which M. caught for himself in the air and ate.
	280	?	?	+	In neither case could I see the insect plainly.
	365	?	?	+	
		Chrysididae.			
278	585	?	AA	+	M. ate this and escaped being stung.
		Scoliidae.			
179	368	*Elis donaldsoni* Fox.	AA	+	M. ate this, which he found when hunting.
		Mutillidae.			
8	14	*Mutilla*, not in Br. Mus.	AA	⊕	The results with these aposematic, powerfully stinging insects seem contradictory. The first that M. ate stung him in spite of having been rubbed on the ground. Immediately afterwards he refused another species; the next one was absolutely refused; some time afterwards another was eaten readily, and again another which he persisted in eating in spite of having been stung, although he had just eaten a number of insects.
9	15	?	AA	− − −	
84	172, 174	*Mutilla*, not in Br. Mus.	AA	− − −	
152	327	?	AA	+	
257	529	*Dolichomutilla guineensis* F.	AA	+	
		Immature stages.			
161	342	Larvae and pupae of a large solitary wasp.		+ +	A large number eaten with relish, to repletion.
53	369, 383, 425	Cocoons of *Megaponera*.		+ +	Always eaten with relish.
111	241	Parasitic cocoons.	AA	− − −	A cluster of minute shining white cocoons was absolutely ignored.

General remarks on the HYMENOPTERA.

Monkeys are most likely to meet with ants and *Mutillidae.* M. evidently recognises Hymenoptera as a group to be feared, for he rubbed several violently on the ground and took especial care to avoid *Megaponera.*

Yet I think that there is little evidence of their being actually *distasteful* in any of the observations; when the monkey did eat one he showed no signs of dislike, and even the three Braconids were eaten without hesitation, considerably to my surprise.

A point of considerable interest is that the larvae and pupae of the ant *Megaponera* were eaten with greatest relish. If the adults were inherently distasteful one would expect to find evidence of it in the *pupae* at least. One is inclined to think that Hymenoptera may be protected by their stinging power rather than by distastefulness.*

COLEOPTERA.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Lamellicornia. **Scarabaeidea.** **Copridae.**			
105	220	*Phalops laminifrons* Fairm.	A	⊜	Bright green.
130	291	?	C	– – –	Dull grey, one of the smallest "ball-rollers."
137	302	*Onthophagus* sp.	A	– – –	Dull black.

General remarks on the COPRIDAE.

They were all absolutely refused by the monkey, which is not surprising if their habits be considered. Many emit a foul odour when handled, their distasteful quality is not recognised by *all* observers, for I shot a roller in 1910 that had several large green Coprids in its crop and nothing else.

		Trogidae.			
231	476	*Trox incultus* Boh.	P	– –	A dull grey beetle, found on old bones and skins. The remarks made on the Copridae apply to them also.
		Melolonthidae.			
114	251, 283	*Schizonycha* sp.	C	– –	Came to light. Both were light brown and I could see no reason why they should be refused.
233	478	*Schizonycha* sp. as above.	C	±	

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* See, however, Trans. Ent. Soc. Lond., 1904, pp. 644–9.—E.B.P.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Cetoniidae.			
11	18	*Glycyphana balteata* Drury.	AA	⊜	An outlying member of the Lycoid colour-scheme.
134	297	?	A	— — —	Bright greenish-yellow.
140	314, 582	*Diplognatha silicia* Macl.	A	— — —	Polished black, or dull chocolate brown.
153	328, 379, 394	*Leucocelis haemorrhoidalis* F.	AA	— — —	Small and abundant, green.
194	400	*Rhabdotis sobrina* G. and P.	P	⊖	Inconspicuous.
237	491	*Pachnoda picturata* Boh.	AA	— — —	Yellow.
249	515	*Plaesiorrhina trivittata* Sch.	AA	— —	Black with large whitish patches.

The Cetoniidae were universally condemned by M., being placed in the minus class without exception. The majority given were conspicuous, and they fly with a very loud noise. No. 153 was noticed to exude a drop of milky fluid when handled. No. 11 is somewhat synaposematic with the Lycidae.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Hybosoridae.			
190	393, 401	*Phaeochrous* sp.	C		Dark brown, found on old bones.

General remarks on the LAMELLICORNIA.

Broadly speaking, all the Lamellicorn beetles were much disliked by the monkey.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Caraboidea. **Cicindelidae.**			
20	30	?	PP	⊕	Both these active, carnivorous beetles, procryptic, were eaten, though one was rubbed on the ground first, as if it were recognised as an insect that might bite.
163	348	?	P	+	

Remarks on the CICINDELIDAE.

Seeing that the Cicindelidae met with were inoffensive, and several species seemed to mimic the offensive Carabidae, it is interesting that the monkey found the two species offered to him decidedly edible.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Carabidae.			
15	22	*Anthia striatopunctata* Guér.	A	– – –	This powerful beetle so frightened M. that he ran away from it.
25	35	*Polyhirma* sp., not in Br. Mus.	A	(≡)	Not a formidable species, but M. showed extreme dislike.
45	65	*Polyhirma calliaudi* Casteln.	A	– – –	Medium-sized, dull black, with white marks.
274	572	Probably same as 45.	A	(±)	Eaten I think to get rid of an unpleasant neighbour.
85	176	*Scarites superciliosus* Kl.	A	– – –	Flat, polished black, with powerful jaws.
269	561	*Scarites* sp.	A	– – –	Like 85. Both probably subterranean.
117	254, 415, 479	*Harpalus* or genus near.	C	(±)	Small, dark, retiring species. M. ate it on one occasion when hungry, but showed it was distasteful by rubbing his hands on the ground afterwards.
168	354	*Piezia* sp., not in Br. Mus.	A	– – –	Black, with dull white markings.
177	363	*Tefflus* sp.	A	(≡)	A very large and formidable black species.
235	484	*Eccoptoptera cupricollis* Chaud.	AA	⊕	M. apparently at first mistook this for a *Mutilla* which it much resembles. This mimetic beetle seems to have lost the characteristic Carabid odour which perhaps explains why M. ate it without sign of dislike.
89	180	Like 117.	C	+	M. was very hungry for insects, as he had had none for several days.
149	324	?	A	+	Medium-sized, delicate, dull black, with brown pubescent markings on elytra.
166	352	?	A	(≡)	Medium-sized, polished black.
229	474, 552	?	A	⊖	Small, black, found under stones.
100	212	Larva.	A	(≡)	Thin and agile, polished black, but not formidable in appearance.

General remarks on the CARABIDAE.

This family of ground-beetles is very likely to be met with by monkeys when turning over dead leaves, sticks, stones, etc.; the species have a characteristic habit of ejecting from the tip of the abdomen a very ill-smelling or even acrid fluid, which in one case (Obs. 22) produced an unpleasant burning sensation on myself. In certain species (*e.g.* our English "bombardier") the fluid is so volatile that it produces a little puff of smoke with an audible noise. The larger species have formidable jaws. It is therefore no matter for surprise that M. showed the strongest dislike to eight of the fourteen species offered him, and to three others a certain amount of dislike. Three others were eaten without evidence of distaste, but in one case there was stress of hunger; one of them was small and delicately made, and perhaps not odoriferous, while the other (235) was a mimic and had certainly lost the Carabid odour.

Besides this very close mimic I think that 25, 45, 168, are of a type of colouring approaching the Mutillid aposeme, though this did not strike me at the time. Dr. G. A. K. Marshall figures some of them in his paper on the bionomics of S. African insects (Trans. Ent. Soc. Lond., 1902, pp. 511–5, pl. xvii, figs. 1–20).

The contrast between the treatment allotted to Cicindelidae and to Carabidae is interesting, seeing that species of Cicindelids met with seemed sometimes to mimic Carabidae.

It is also worth noting that the polished black larva (Obs. 212) was treated as extremely distasteful. This may be compared with the remarks on the Hymenoptera in their immature stages.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Polymorpha. **Silphidae.**			
199	419, 440	*Silpha micans* F.	A	– –	A sea-green beetle found on a giraffe skull.

Exactly the same remarks may be made of this and the following family as of the Copridae.

		Histeridae.			
21	31, 304	*Hister validus* Erichs.	A	(---)	Flat, smooth, polished black.
135	299	*Saprinus rasselas* Mars.	A	– – –	Greenish-black. Found under a bone.
136	300, 303	*Saprinus cruciatus* F.	AA	– – –	Bright orange elytra. Found with above.
		Coccinellidae.			
50	74, 121, 331, 559	*Alesia striata* F.	A	++	Pink and black. Common on grass tips.
98	207, 370, 410	*Epilachna chrysomelina* F.	A	++	Dull orange, black spots. Very abundant. Emitted acrid yellow fluid from joints when handled.
254	521, 526	*Epilachna paykulli* Muls.	A	±	Dull pink, black dots. Very abundant.
51	83	?	A	+	Bright pink and yellow with black marks. M. chose this for himself when out hunting.
88	179	?	AA	+	Shining black, two red spots. Emitted yellow fluid.

General remarks on the COCCINELLIDAE.

The "ladybirds," for all their small size, appeared to be typically aposematic. These beetles with their bright colours, bold markings, habits of living freely exposed and of emitting acrid yellow fluid, might be expected to be condemned; yet M. ate several without sign of dislike and one quite eagerly. More experiments would be of interest.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Malacodermidae. **Lycidae.**			
10	16, 29	*Lycus constrictus* Fähr.	AA	– – –	
86	177, 181, 201, 230, 416	*Chlamydolycus trabeatus* Guér.	AA	– – –	In the ♂ the elytra enormously expanded.
198	417, 437	*Merolycus femoralis* Bourg.	AA	– – –	
218	455	*Merolycus dentipes* Dalm. var. *flavoscapularis* Bourg.	AA	– – –	
236	485	*Merolycus podagricus* Bourg.	AA	– – –	
?	367	?	AA	– – –	

General remarks on the LYCIDAE.

These beetles have a single scheme of colouring; orange or orange-brown with limbs black or black and orange, and tips of the elytra black. They have in a typical degree the habits of aposematic insects and freely and fearlessly expose themselves. Large numbers may be found congregated on a single flowering shrub. Dr. G. A. K. Marshall has drawn attention to the large number of insects of all classes that have been influenced by this predominant type, and several are dealt with in these experiments (Trans. Ent. Soc. Lond., 1902, pp. 515–8, pl. xviii, figs 1–52). The monkey put all the Lycidae in the most distasteful class. Twelve observations were made and only twice were these beetles tasted (Obs. 416, 417) under influence of hunger. Sp. No. 198 was tasted once and absolutely refused on the second occasion, when M. was less hungry. A rank odour was noted in Obs. 29.

		Lampyridae.			
49	73	*Luciola* sp., not in Br. Mus.	C	– – –	A light grey and dull yellow "firefly."
283	600	Larva.	A	– – –	Black and pink; like larval "glow-worm."

Remarks on LAMPYRIDAE.

It is to be expected that fireflies and glow-worms are distasteful, or else they would soon be destroyed by bats. The distastefulness of the larva is interesting.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Melyridae.			
63	123, 132, 506, 551	Genus near *Prionocerus* sp. with pattern of *P. dimidiatus*, but not in Br. Mus.	AA	– – –	A Lycoid species very abundant and conspicuous on grass tops. Emits yellow oil when handled.
		Elateridae.			
27	37	?	P	+	A dark brown species that came to light.
		Buprestidae.			
43	62, 67, 70, 101, 151, 169, 386	*Sternocera pulchra* Waterh.	A	±	A large blue-green species with orange pubescence: quite conspicuous, flies with loud hum.
129	290	*Sternocera boucardi* Saund.	A	–	Extremely conspicuous: the largest species offered. Grey-green, spotted with yellow pubescence.
47	69, 570	*Agrilus discolor* Fåhr.	A	±	Brightly coloured; rather like a common scheme of colouring in Hemiptera.
240	494	*Agrilus beryllinus* Fåhr.	PP	++	Small, bright green.
95	203	*Sphenoptera* sp.	P	+	Small, dull purplish-brown.
242	497, 593	*Sphenoptera disjuncta* Fåhr.	P	++	Dull bronze; sits rather close on twigs; quick to take alarm.
164	349	*Acmoeodera* sp., not in Br. Mus.	C	+	Small, greenish-yellow, black markings.
183	378, 566, 605	*Steraspis* sp., not in Br. Mus.	*a*	++ ++	Dull bronze; freely exposed on foliage.
224	465, 573	*Agelia peteli* Gory.	AA	++	Extremely conspicuous on foliage; large, black, with greenish-white and orange blotches.
260	539	*Discoderes* sp., not in Br. Mus.	PP	++	See description—a peculiar species.

General remarks on the BUPRESTIDAE.

From the point of view of the present paper this family is rather puzzling. On the whole these beetles are considered as edible; but the monkey seemed to find them very hard.

Sp. No. 43 was not eaten with zest at first, and the successive observations show that when the monkey had learnt to break up the beetle it was eaten readily. This, and the other large species, No. 129, appear to have a means of defence by pinching between the posterior edge of the dorsum of the thorax and anterior edge of the elytra.

When the beetle is handled this gap is opened widely (Obs. 62), and the monkey on one occasion got his tongue severely pinched (Obs. 70).

The larger species fly with a loud buzz and are extremely conspicuous on the wing. The undoubted hardness of the Buprestidae may be the quality with which their aposematic colours are associated, for they do not seem to be actually distasteful.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Heteromera. **Tenebrionidae.**			
13	20, 134, 228, 472	*Macropoda transversalis* Kolbe.	A	±	Rotund, large, black, very active beetles, which run about freely and may often be seen feeding on dead grasshoppers, etc.
24	34, 145	*Physophrynus*, sp. n.	A	(=)	
36	53, 375	*Lamprobothris fossulata* Müll.	*a*	— —	Dull purple shagreen, small.
46	68, 334	*Vieta* sp. ? *vestita* Gory.	P	(≡)	Light earth-brown; fine upstanding bristles on elytra.
69	133, 558	*Rhytinota gracilis* Gerst.	A	±	Smooth, polished black.
225	467	*Rhytinota acuticollis* Fairm.	A	— —	,, ,, ,,
167	353, 452	*Anomalipus heraldicus* Gerst.	*a*	— — —	Large, grey, flat, sluggish.
182	376, 496	*Praogena splendens* Mäkl.	A	— — —	Dull purple: freely exposed.
192	396, 516, 575	*Anchophthalmus clathratus* Gerst.	C	(=)	Grey or black, like a Silphid in shape.
215	447, 471, 531	*Catamerus revoili* Fairm.	AA	(=)	Large, dull blue-black, sluggish.
220	458	*Zophosis pterygomalis* Gebien.	C	— —	A flat grey species running about actively.
289	614	?	C	±	Like a large ground-weevil, dark grey. [Fragmentary: may be a weevil.]
156	336	Larvae, possibly of 215.	A	—	Gregarious, freely exposed on twig, blue-black.

General remarks on the TENEBRIONIDAE.

The beetles of this family, unattractive and of sombre hue, are often likely to be met with on the ground by monkeys, and some are extremely common.

Not one of the twelve species given to M. was regarded as really edible, and only three were eaten with great doubt.

It is also interesting to note that the larvae of one species were rejected.

		Lagriidae.			
59	114, 209, 513, 533	*Lagria rhodesiana* Péring.	*a*	— —	A dull, purplish-brown, small beetle, very common on grass tops.
		Meloidae.			
6	11, 111, 156, 271	*Coryna dorsalis* Gerst.	AA	— — —	Black with yellow marks.
7	12, 347	*Mylabris tristigma* Gerst., var.	AA	— — —	Black and orange.
241	495	*Mylabris amplectans* Gerst.	AA	— — —	Black and orange.
32	42	*Cyaneolytta coelestina* Haag.	AA	(≡)	Like an "oil-beetle," dull purple.

Remarks on the MELOIDAE.

These beetles fulfil all the canons of typically aposematic insects; they were found feeding freely exposed on flower petals, except No. 32, which, having no wings, has only been seen crawling on the ground like our English "oil-beetle." The others fly with a sonorous buzz. M. put them all in the most distasteful class, and on the only occasion when he bit one was in a frolicsome mood and had no idea of eating it; he made wry faces afterwards (Obs. 42). On only one occasion did he seem even to notice these common and very conspicuous beetles when out hunting (Obs. 271).

The quality which protects these beetles, which seem to come very near absolute inedibility, is brought to its highest perfection in the "oil-beetles" and allied Cantharidae or blister-beetles.

It is seen that the Heteromera given to or encountered by the monkey were all of them regarded as distasteful.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Phytophaga. **Sagridae.**			
197	413, 459	*Sagra* sp., not in Br. Mus.	AA	— — —	A large dull, blue-black species.
		Megalopidae.			
195	407, 509, 588	*Poecilomorpha apicata* Fairm.	AA	— — —	A "Lycoid" species.
		Clytridae.			
2	2, 4, 48, 52, 124	*Clytra wahlbergi* Lac.	AA	— —	Black and scarlet.
271	567	*Tituboca sansibarica* Lefevr.	A	—	Yellow-brown, four black dots.
272	568	*Diapromorpha*(*Peploptera*) sp. nr. *curvilinea* Jac.	*a*	— — —	Greenish-brown, black lines.
		Cryptocephalidae.			
72	141	?	AA	±	Black and scarlet.
116	253	*Cryptocephalus* sp., not in Br. Mus.	A	— —	Black and lemon yellow.
		Eumolpidae.			
12	19	*Pseudocolaspis* sp.	C	±	Dull bronze, pubescent.
150	325, 411	*Colasposoma* sp.	*a*	+	Dull bronze, rounded, freely exposing itself.
188	389, 402, 422, 456, 486, 617	*Euryope batesi* Jac.	AA	⊖	Bright orange with black limbs; extremely common and conspicuous.
193	397, 514, 612	*Corynodes usambicus* Klb.	A	±	Bronze green, thorax tinted witb purple.
216	453, 511, 589, 616	*Corynodes raffrayi* Lefevr.	AA	⊜	Very like 188, but dull red rather than orange.
		Chrysomelidae.			
48	72, 208, 214,	Prob. a *Lygaria*, not in Br. Mus.	A	±	Pink and black, rather like a ladybird.
217	454	*Chrysomela* sp.	*a*	— — —	Round, dull bronze, exposes itself freely.
		Halticidae.			
3	3, 10, 155	*Physodactyla gerstaeckeri* Jac.	AA	— —	Orange, with black limbs, like 188.
76	152	Prob. *Blepharida* sp., not in Br. Mus.	P	±	Speckled brown and grey.
14	21, 51, 78	*Polyclada* (*Diamphidia*) sp., not in Br. Mus.	AA	±	Orange head and thorax, black elytra.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
258	530, 597	*Diamphidia* sp. nr. *femoralis* Gerst.	AA	— —	Orange with black limbs, like 188. Rather shy.
		Galerucidae.			
37	54	*Megalognatha* sp.	AA	— — —	Small, black and light brown; pregnant female has the swollen abdomen bright yellow.
54	102, 202, 457, 535	*Diacantha conifera* Fairm.	AA	— — —	Orange and black like a Lycid.
196	409, 418	*Diacantha* sp. nr. *conifera.*	AA	— — —	Like above but paler yellow.
180	374	*Diacantha petersi* Bertol.	A	— — —	Gravid female with swollen orange abdomen and green elytra.
77	153	*Ootheca mutabilis* Sahlb.	A	—	Orange thorax, blue elytra.
279	586	*Exosoma ugandaensis* Jac.	A	— — —	Small brown and black, gregarious.
		Cassididae.			
1	1, 9, 154	*Cassida* sp.	AA	— —	Orange with black spots.
38	55, 59, 426, 434, 512	*Aspidomorpha hybrida* Boh.	A	— —	Bronzy-green.
251	517	*Aspidomorpha quadrimaculata* Oliv.	A	— — —	Tinted with pink, and with small black spots.
284	601	*Aspidomorpha praecox* Boh.	A	— — —	Dull crimson with black pattern.
280	590	?	A	— — —	Fiery orange-pink, spotted with black.
		Family unknown.			
131	292	Larva.	AA	— —	Dull pink, feeding gregariously on a web.
160	341	Larva.	AA	—	Large, dull black with orange head.

General remarks on the CHRYSOMELIDAE *and their allies.*

Thirty-one species were offered, including two larvae, and all save one were treated as more or less distasteful. Almost all of them were aposematic, and specimens of sundry families formed synaposematic groups, *e. g.* No. 2 (Clytridae) and No. 72 (Cryptocephalidae) were black and scarlet; Nos. 188 and 216 (Eumolpidae), Nos. 3 and 258 (Halticidae) were orange with black limbs; No. 195 (Megalopidae), No. 54 (Galerucidae) were of the Lycoid type of coloration; and one Chrysomelid (No. 48) was very like a "ladybird." The sole Sagrid tested was much like our English "bloody-nosed beetle" in general appearance, habits, and conspicuousness.

It is of interest that two species of larvae, both aposematic, were also classed as distasteful.

The Cassididae are particularly interesting, for some, such as our English common green species, must undoubtedly be classed as procryptic, yet the monkey had no doubt about the distastefulness of five species offered him on eleven occasions.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Cerambycidae.			
244	499, 598, 603	*Anubis (Oligosmerus) limbalis* Har.	C	+	Small, bright green, with fragrant smell.
		Lamiidae.			
52	98, 99	*Dirphya similis* Gah.	AA	–	Black and orange, slender, Braconoid.
75	147, 343, 390	*Phantasis zanzibarica* Gerst., or closely allied sp.	*a*	±	Of very unusual form and habits; dull black; probably mimetic of the hard weevil No. 74.
226	468	?	P	+	Dull blue-black, spotted with buff.
255	524	?	PP	++	Bark-brown with two whitish blotches.
259	538	?	PP	+	Grey.
263	542	*Spilotragus xanthus* Jord.	C	+	Small, light grey and yellow: Possibly somewhat Hymenopteroid.

General remarks on the LONGICORNS.

These beetles are extremely likely to be met with by monkeys, and in one case (Obs. 468) the monkey seemed clearly to recognise the edibility of the beetle from a distance. A large species of Lamiid mimicking a common type of Braconid was definitely classed as distasteful.

The very abnormal species 75 seemed to me definitely to be mimicking a large and very hard ground-weevil found almost at the same time and place on the same day; it has only been found walking slowly on the ground. The only Cerambycid tested was a very abundant bright green species with characteristic odour, but I was unable to class its coloration. When found on yellow composite flowers it was very conspicuous, yet among green foliage it must be well concealed; its behaviour, however, is not that of a typically procryptic insect.

Every one of the species offered stridulated by strong nutation of the thorax except No. 75, but the monkey seemed to take no notice of this save in Obs. 98.

		Curculionidae.			
66	127	*Apoderus balteatus* Pér., var.	C	++	Yellow with pink elytra; perhaps resembles a leaf-gall.
68	130	*Microcerus* sp. nr. *annuliger* Har.	PP	++	Stone-colour.
221	460, 562	*Microcerus spiniger* Gerst.	C	±	Black, very hard.
96	205	*Attelabus pustula* Anc.	PP	+	Resembles red leaf-gall.
165	350	*Larinus* sp.	PP	++	Soft browns and greens.
202	423	*Alcides leucogrammus* Er.	PP	++	Striped longitudinally dark and light.
97	206, 257, 268, 492	*Isaniris* sp., probably new.	P	++	Black, speckled with whitish.
252	518	*Blosyrus haroldi* Hartm.	PP	++	Stone-colour.
253	519, 613	*Lixus* sp.	P	++	Large, covered with yellow bloom.

Sp. No.	Obs. No.	Name.	Colour.	Edi-bility.	Remarks.
261	540	*Baris* sp.	*p*	++	Small, black.
281	594	*Alcides* sp.	PP	++	Dark bark-brown.
26	36	?	PP	++	A ground-weevil of earthy colour, hard, rugose.
74	146	?	*a*	±	Very large, dull grey, sluggish, very hard.
146	321, 332	?	P	++	Black, speckled with whitish.
204	432	?	PP	++	Soft browns and greens.
285	604	?	PP	++	Light grey with longitudinal dark stripes.

General remarks on the CURCULIONIDAE.

These beetles appear to be eminently edible, and procryptic. Only two species were treated at all doubtfully and both appeared to be very hard; one of them (74) seems to be a model for the abnormal Longicorn 75. (See Obs. 147.)

It is hardly possible to get a more interesting contrast than that between the weevils and the group of Chrysomelidae and the allied Phytophaga.

The weevils are P and +, the latter A and —. The table in Section III of this paper shows this very graphically. Yet both are vegetarian and have similar habits in the adult state. It was particularly interesting in the field to find side by side on the same plants the Eumolpid 188 (AA —) and the weevil 253 (P ++), one relying for protection upon advertisement, the other upon concealment.

		LEPIDOPTERA. **Danaidae**			
286A	606	*Danaida chrysippus* L.	AA	±	Orange-brown with black-and-white tip.
286B	609	Do. form *dorippus* Klug.	A	±	All orange-brown.
		Satyridae.			
107	223	*Neocoenyra* prob. *gregorii* Butl.	P	+	Brown, with reddish "Eye-spots."
		Acraeidae.			
104	219, 225, 317	*Acraea caldarena* Hew., f. *neluska* Oberth.	AA	— —	For an *Acraea* this is wary and difficult to catch.
141	315	*Acraea neobule* Dbl.	AA	—	Both these are thinly scaled, black and pink.
		Nymphalidae.			
80	163	*Precis clelia.*	P	?	M. took no notice of this when hunting; if he *did* perceive it, it should be in — — — class.
93	199, 293, 481	*Precis cebrene* Trim.	P	++	Large orange blotches on dark ground.
151	326	*Precis sesamus* ⊗.	A	+	This wet-season salmon pink form is held by Prof. Poulton to be synaposematic.
171	357	*Precis antilope* Feisth. ⊗ = *simia* Wallgrn.	A	+	Closely resembles the above.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
173	359	*Precis natalica* Feld.	P	++	Black and brown.
113	250	*Hypolimnas misippus* L., ♂.	A	?	M. when out hunting made no effort to catch this, which was sitting on the ground.
120	260	*Hypolimnas misippus* L., ♀.	AA	±	Mimics 286A.
211	443	,, ,, *misippus* L., ♀ f. *inaria*.	A	±	Mimics 286B.
169	355	*Neptis agatha* Cram.	A	+	Conspicuous black and white.

General remarks on the NYMPHALIDAE.

For the purposes of this article the coloration classified is that of the *under-side*, which is of most importance, since it is all that shows when the butterfly is in the condition of complete rest. Thus many *Precis* are brightly coloured above, but very procryptic below. It is interesting that the *Acraea* seemed more distasteful than *Danaida chrysippus*, and that *Hypolimnas misippus*, synaposematic with the latter, was put at about the same level.

Precis sesamus and *P. antilope*, the wet-season aposematic forms, were not treated as distasteful.

		Lycaenidae.			
62	119	*Axiocerces harpax* F.	PP	++	

I have not offered Lycaenids to the monkey because their very small size makes them hardly worth while; their edibility to *birds* is another matter. But the above species (upper surface richly copper-coloured, under surface russet-brown) is of some especial interest, owing to the fact that the curiously twisted "tails" on the hind-wing aid very greatly in the procrypsis when the butterfly is in the position of complete rest for the night. The following quotation from an entry in my journal of January 13th, 1917, illustrates this: "Several species of Lycaenids were seen disposed for the night on shrubs, among them No. 62, which is very common here; this was a ♀. Both antennae projected straight out in front just above the surface of the leaf on which the butterfly sat. The fore-wings were completely covered by the hind-wings except for their extreme tips; the third silver spot on the costa (counting from the tip) being half covered by the hind-wing, and half exposed. The tails on the hind-wings projected almost vertically (in a line almost directly above the base of the abdomen, the whole of which was exposed) and were not close together. After I had seen this specimen at rest I twice thought that bits of twisted dead leaves on other bushes were butterflies of this species." I may add that when the Lycaenid is flitting about and settles temporarily this attitude is not adopted; the tails then project backwards, and the antennae upwards as is usual.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Pieridae.			
103	218	*Terias senegalensis* Boisd.	P	+	Greenish-yellow.
106	221	*Teracolus evagore* Klug., f. *antigone* Boisd.	P	+	Orange-tipped above; below often suffused with pinkish or brownish scales.
108	224	*Teracolus achine* Cram.	P	+	
132	294	*Teracolus vesta* Reiche.	P	+	Yellowish-white, black tips.
212	444, 545	*Teracolus eris* Klug.	P	++	White, black bar on f.w. and bistre tip.
170	356, 580, 608	*Mylothris agathina* Cram.	A	±	Bright orange-yellow with red "flush."
142	316, 442	*Pinacopteryx simana* Hopff.	P	++	White, suffused beneath with grey scales.
172	358, 510, 578	*Belenois mesentina* Cram.	P	++	Black and white above; beneath chequered black and white with yellowish ground tint.
174	360, 577	*Catopsilia florella* Fabr.	P	±	Greenish-white.
264	544, 579	*Eronia cleodora* Hübn.	PP	±	See Obs. 544 for description.

General remarks on the PIERIDAE.

On the whole the monkey seemed to find them not unpleasant, but was rather doubtful about No. 170, the only aposematic species offered. The same doubt was manifested towards the most procryptic of all (No. 264) and its near relation 174. It must be remembered that, as with other butterflies, the classification of their coloration is founded upon the *under* surfaces of the wings.

No. 170 is very conspicuous on the wing, and when the butterfly is drinking from mud the orange-red flush at base of hind-wing offers an easily recognisable mark; the "mud-drinker's aposeme."

The apparent slight distastefulness of the highly procryptic 264 is rather unexpected.

The Pierines generally become much more procryptic in the dry season, when the under surface acquires a suffusion with pinkish, brown, or grey scales, causing them to harmonise admirably with the tints of the dried grass among which they settle.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Papilionidae			
121	262	*Papilio angolanus* Goeze.	A	+	Black and white with good deal of red at base.
147	322	*Papilio leonidas* F.	AA	+	Mimetic of *Melinda petiverana* Dbl.-Hew.
		Hesperidae.			
4	6	?	P	++	One of the small black-and-white species.
29	39	*Rhopalocampta forestan* Cr.	C	+	The large white patch on the under-side of the dusky wings makes it uncertain how to classify this butterfly.
265	547	*Cyclopides willemi* Wallgrn.	P	+	Frequents long grass; marked with radiating streaks.
		Heterocera.			
		Zygaenidae.			
234	482	*Neurosymploca xanthosoma* Jord.	A	−−	A dull greenish-black species. See below.
262	541, 543, 574	*Neurosymploca xanthosoma* Jord.	AA	−−−	Black, with bright yellow abdomen which particularly attracted M.'s attention.
		Agaristidae.			
209	441	*Xanthospilopteryx superba* Butl.	AA	±	Black, crimson, and dull yellow; flight typically aposematic.
		Hypsidae.			
287	607	*Argina amanda* Bd.	AA	−	Bright orange speckled with black.
		Notodontidae.			
184	382, 414	*Anaphe ambrizia* Butl.	AA	±	Creamy white with coarse brown pattern. Sits freely exposed on leaves.
		Noctuidae.			
122	275	?	C	+	Large dark brown moth with conspicuous pale eye-like markings. M. endeavoured to catch this when hunting.

General remarks on the MOTHS.

All the aposematic species were treated as distasteful. The Hypsid was adjudged more distasteful than *D. chrysippus*, which is of interest since some of the moths of this family enter into synaposematic relations with other species of Lepidoptera.

LEPIDOPTERA—(*continued*).

Larvae.

		Sphingidae.			
60	115	*Deilephila ?*	P	++	An apple-green larva (see Note, Obs. 115).
		Saturnidae.			
83	171	?	AA	−−−	Large, conspicuous larva armed with stout spines.
110	235	?	AA	−−−	
		Lasiocampidae.			
175	361	?	A	−−−	Yellow with black dots.
		Arctiidae.			
112	246	?	A	−−−	Clothed with dense very long black hairs.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Lymantridae.			
127	287	?	A	– – –	Dark, with short grey hairs, very irritating.
185	384, 412, 424, 433	Pupa ? sp.	AA	(±)	See note on Obs. 384.
		Psychidae.			
154	333	?	?	– – –	It was always a surprise to me that M. never made any attempt to break open the Psychid larva-case.
		Geometridae.			
90	184	?	A	±	Black.
256	528	?	PP	+	Colour of a dried grass stem.
—	90	**? Family.**	A	– – –	

General remarks on the CATERPILLARS.

From the way in which M. actually devoured 60 and 256, I do not think caterpillars can be much eaten by monkeys—they are too soft and "squashy." The monkey likes insects he can crunch up.

DIPTERA.

		Tabanidae.			
158	339	*Haematopota* sp.	C	+	
159	340				
		Asilidae.			
67	129	*Hoplistomerus serripes* F.	A	– – –	Mimetic of Hymenoptera perhaps a Scoliid.
73	142	?	C	+ +	
		Syrphidae.			
61	117, 216, 259	*Eristalis tenax* L.	A	– – –	The common "drone-fly" mimicking the Honey-Bee.
		Muscidae.			
157	338	*Glossina morsitans* Westw.	C	+	The "tse-tse" fly.
		Tachinidae.			
30	40	*Chromatophania distinguenda* Vill.	A	– – –	Conspicuous brown and pink hairy fly.
		Ortalidae.			
223	464, 548, 553	*Bromophila caffra* Macq.	AA	– –	Large black fly with coral-red head; very conspicuous.

General remarks on DIPTERA.

Flies are not likely to form the food of monkeys to any great extent. Obs. 338, 339, 340 show that M. caught and ate biting flies, but I think this was probably a means of disposal of unwelcome neighbours.

The cases of the mimetic species 67 and 61 show that M. was deceived by resemblance to Hymenoptera; he did not refuse a non-mimetic Asilid. Nos. 30 and 223, both conspicuous, were refused; and the monkey evidently agreed with me that the *Bromophila* was a disgusting-looking insect!

HEMIPTERA.

Heteroptera.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Pentatomidae.			
41	58, 204, 252	*Callidea bohemani* Stål.	AA	— —	Brilliant green and gold.
44	64, 182, 380	*Aspongopus viduatus* F.	A	— —	Large, brown and black.
55	103, 137, 498	*Agonoscelis puberula* Stål.	P	— —	Small, dull, inconspicuous.
123	277	*Agonoscelis versicolor* F.	P	— — —	Small, grey, speckled yellow, inconspicuous.
148	323	*Sphaerocoris testudogrisea* De G., var. *pardalina* Schm.	AA	— — —	Like a *Coccinella*, malodorous, orange with black spots.
206	436	?	A	+	Larva; blue; possibly same as 41, noted as malodorous.
40	57	?	P	±	Larva; grey, bark-like.
187	388	?	A	±	Larva; black, with orange spots; found congregated together.

Remarks on the PENTATOMIDAE.

Except for one larva these bugs were definitely classed as very distasteful, though two species at least were procryptic. They are strongly malodorous.

		Coreidae.			
42	61, 77, 109, 125, 135, 144, 150, 157, 226, 261, 270, 307, 320, 571,	*Anoplocnemis curvipes* F.	A	(‡)	Large, blackish-brown, very common.
228	473	*Cletus ochraceus* H. S.	P	±	Small, brown, inconspicuous.
133	295, 298	?	P	+	Larva; very alert, slipping round the stem of the plant to escape notice.

Remarks on the COREIDAE.

No. 42, though very malodorous, was regarded as quite a dainty, although the monkey was obviously afraid of its proboscis and often rubbed it on the ground.*

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* *A. curvipes* was also eaten greedily by Dr. G. A. K. Marshall's baboons, although rejected after trial by a kestrel (Trans. Ent. Soc. Lond., 1902, pp. 345, 382–3).—E.B.P.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Lygaeidae.			
65	126, 128	*Lygaeus* sp., not in Br. Mus.	AA	— —	Black and red.
189	391, 399, 404	Probably same as 65.	AA	+	Larvae; black and orange, congregated.
101	213	*Lygaeus militaris* F.	AA	⊜	Rose and grey.
191	395, 403	*Lygaeus festivus* Thunb.	AA	⊜	Black and rose.
87	178, 615	*Oncopeltus famelicus* F.	AA	—	Black and orange larvae, congregated.

Remarks on the LYGAEIDAE.

All the species tested were aposematic and treated as distasteful. But it is curious that the congregated larvae of No. 65 (189) were apparently not distasteful, though the larvae of 87 were unpalatable (Obs. 615).

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Pyrrhocoridae.			
118	256, 258	*Dysdercus superstitiosus* F.	AA	±	Rose and grey, congregated together.
222	463, 584	*Roscius illustris* Gerst.	AA	—	Large, black with orange spots, red head. Highly conspicuous.

Remarks on the PYRRHOCORIDAE.

Both species offered were treated as distasteful.

Sp. No.	Obs. No.	Name.	Colour.	Edibility.	Remarks.
		Reduviidae.			
31	41	?	A	±	Slender, black speckled with yellow.
39	56	?	A	+	Grey with tips of tegmina reddish.
268	560	?	A	(±)	Powerful black apterous species.
		Family not known.			
28	38	?	AA	±	A solid rose-pink, apterous specimen found on dead tree. ? young of 162.
162	344	?	P	+	Rose-pink body concealed by grey tegmina.
205	435	?	A	+	Possibly same as 44 (Pentatomid).
		Homoptera.			
		Fulgoridae.			
200	420	*Pyrops marginatus* Westw.	PP	—	Grey, with long snout, very procryptic.
239	493	*Hypselometopum morosum* Westw.	PP	—	The waxy abdomen particularly attracted M.'s attention.
		Cercopidae.			
207	438, 534, 569	*Triecophora conspicua* Dist.	AA	— —	Extremely conspicuous.

Remarks on the HOMOPTERA.

Although two species were extremely procryptic, all were treated as distasteful.

General remarks on the HEMIPTERA.

It is seen that the verdict upon the group as a whole is decidedly unfavourable, although quite a number are very definitely procryptic. The powerful, and to man, unpleasant odour does not, however, seem to be a cause of distastefulness, seeing that the very malodorous large Coreid, No. 42, seemed to be a pleasant article of food, although M. seemed to fear its powerful rostrum.

SECTION III.

FURTHER EXPERIMENTS WITH A CERCOPITHECUS ON RELATIVE EDIBILITY OF INSECTS.

At the beginning of February, 1917, the young male monkey which I had borrowed for the purpose of experiment was reclaimed by his master and, much to my regret, I lost him. There was, however, another monkey in the station, and I continued the taste-experiments with him. He also was a young male of the same age, and, so far as I could tell, of the same species of *Cercopithecus ;* he was of the common grey-green type with black hands and face and dull whitish band across the forehead. His temperament, however, was different from that of M_1,— he was quieter and not so boisterous, and at first not nearly so ready to eat insects. His owner, who had kept him from babyhood, had never given him insects to eat and, as he had always been kept tied up (when I experimented with him he was on the upper balcony of a house), he had probably not had much, if anything, in the way of insect food.

His manners were somewhat different from those of M_1. Sometimes when dealing with a very objectionable insect that M_1 would have rubbed violently on the ground, M_2 would leap up in the air and come down heavily with one hand on the insect, which would thus be disabled.

Owing to the fact that M_2 was not under my control I was not able to supervise his feeding entirely, as I had done with M_1, so that, except for the fact that he soon showed whether or not he was hungry for *insects*, I could not tell in what state he was at the commencement of an experiment.

The experiments were carried out, and records made, in precisely the same manner as described in the M_1 series of experiments. A total number of 131 species were used for M_2, of which 55 had been previously tested on M_1. These latter therefore were doubly tested, and a table at the end of the paper, comparing the treatment of the two monkeys, brings out some interesting points of difference.

Series a. Obs. 616—619. *Feb.* 6.

Obs. 616. *Sp.* 44.—Pentatomid, probably *Aspongopus viduatus :* a large dark brown bug. When it flies it exposes the red upper surface of the abdomen. It was offered in a box with a specimen of the Tenebrionid beetle *Macropoda transversalis,* and was taken out in preference to the beetle. M_2 examined it very attentively, bit off and ate the head and thorax, then pulled open the tegmina and wings so that the red abdomen was exposed, and then dropped the insect, which gave out the typical rank " bug " odour.

Obs. 617. *Sp.* 13.—The Tenebrionid beetle was picked up, bitten, and dropped.

Series β. Obs. 620–637. *Feb.* 7.—At 11 a.m., M_2 very hungry.

Obs. 620. *Sp.* 67.—Asilid, *Hoplistomerus serripes :* M_2 appeared to be deceived by the Hymenopteroid appearance of this fly : he looked at it very suspiciously, took it up gingerly, and put it down. As he was not stung he took it up again, re-examined it, bit off its head and finally ate the fly with appreciation.

(*Note.*—The behaviour of the monkey was most interesting and very strongly suggested that this fly is a true Batesian mimic, *i. e.* pseudaposematic and edible.)

Series γ. Obs. 638–651. *Feb.* 7.—At 5 p.m. M_2 was quite ready for more insects.

Obs. 638. *Sp.* 186.—Six staple grasshoppers (*Catantops decoratus*) eaten greedily.

Obs. 639. *Sp.* 262.—Zygaenid, *Neurosymploca xanthosoma :* this moth was offered in the lid of a chip box. M_2 smelt it once, then for a time paid no more attention to it. As I still held it out to him he put out a hand and touched it. The Zygaenid lifted its wings so as to expose the bright yellow abdomen, hitherto concealed. M_2 would then have nothing more to do with the moth.

(*Note.*—The deliberate exposure of an aposeme by the moth, when interfered with, and the recognition of it as such by the monkey, are of much interest. When this moth, of a universal dull black, save for a yellow spot on each side of the thorax, and the yellow abdomen, is quietly at rest on a grass stem the wings completely cover the abdomen. But the abdomen is quite conspicuous when the moth flies, with the typical straight, heavy flight of the family.)

Obs. 640. *Sp.* 195.—Megalopid, *Poecilomorpha apicata :* this Lycoid bettle was smelt, put up to the mouth, tasted, and thrown away. After a little time M_2 jumped down, picked up the beetle and pulled it to pieces, but tasted none.

Obs. 641. *Sp.* 244.—Cerambycid, *Anubis* (*Oligosmerus*) *limbalis :* M_2 looked doubtfully at this bright green Longicorn, but ate it without definite sign of distaste.

Obs. 642. *Sp.* 295.—Pentatomid Bug of same type as 44, with reddish upper surface of abdomen. This was handled very doubtfully, turned over and over; the tip of the abdomen was tasted, but obviously not much relished. At last M_2 appeared to make up his mind to face a nasty morsel and ate it up quickly, and then jumped down and ate some dates immediately.

Obs. 643. *Sp.* 242.—Buprestid, *Sphenoptera disjuncta :* this beetle was taken without hesitation and eaten with gusto.

Obs. 646. *Sp.* 296.—Cerambycid, *Phyllocnema* sp. : about the size of the "musk beetle" and smelling like it. Deep blue with brownish-yellow legs banded with dark blue, the hind tibiae each having a large flat expansion of blue colour, the antennae brown at base, blue at ends. This beetle is very aposematic on the wing, as I first saw it. It was offered to M_2, who looked at it but no more. After a few minutes it was offered again : M_2 gave it one bite and quickly dropped it.

Obs. 649. *Sp.* 297.—Hesperid, *Leucochitonea hindei :* a large white skipper with black apex to the fore-wing. Offered to M_2, but he made no attempt to take it.

(*Note.*—This butterfly has the same general appearance as many of the white species of the Pierine genus *Belenois*. Like them it frequents puddles, and drinks with them. I have often seen *Belenois* settle close by it when it had alighted on the mud with wings expanded; it almost appeared as if the *Belenois* chose to settle with it because of the resemblance, for it is well known how species of the same coloration keep together when assembling at mud. The first of these skippers that I saw seemed to me strongly suggestive of a small *Belenois*.

It is to be noted that M_2, who made no attempt to take this butterfly, did not appear to find *Belenois* nearly as palatable as M_1 had done.)

Obs. 650. *Sp*. 174.—Pierine, *Catopsilia florella:* M_2 would only take this greenish-white butterfly when persuaded; he pulled it about much, ate the abdomen and, after more pulling about, ate the thorax.

Obs. 651. *Sp*. 298.—Pierine, *Teracolus eupompe* Klug: a white butterfly with crimson tips. M_2 pulled off the wings and ate the body with no sign of dislike.

Series δ. *Obs*. 652–683. *Feb*. 8.—At 2 p.m., M_2 being very ready for insects. He ate 9 grasshoppers and refused *Dictyophorus productus*.

Obs. 656. *Sp*. 300.—Lamiid, *Ceroplesis malepicta* Fairm.: a Longicorn beetle of medium size, dull black with dull red bands, found sitting freely exposed on low herbage. M_2 pawed it a little, took and bit it quickly, then put it down. This beetle is decidedly aposematic.

Obs. 657. *Sp*. 301.—Locustid (possibly same as 203): a short, fat, wingless, green grasshopper. M_2 took it, bit the abdomen, then put the insect down, and allowed it to crawl. As I made a movement to take it M_2 seized it and hastily bit it up, but it was quite obvious from his previous behaviour that he had not intended to eat it.

Obs. 663. *Sp*. 304.—Phytophaga: a dull black beetle, with dull orange thorax, found sitting conspicuously on a leaf, and giving out a yellow juice when handled. M_2 pulled off the elytra, but ate the beetle without any sign of dislike.

Obs. 664. *Sp*. 305.—Reduviid, *Phonolibes bimaculatus* Dist., or allied species: a dull black bug with rose-coloured abdomen. It was offered on my hand; M_2 smelt it and left it alone.

Obs. 676. *Sp.* 286 B.—*Danaida chrysippus*, form *dorippus*: the all-orange-brown variety. The butterfly was offered between my fingers, held by the body. M_2 took it, let it go, caught it again, tasted it, pulled it about, nibbled the abdomen, looked at his fingers as if he had soiled them, put down the butterfly and allowed it to be blown a little distance away, caught it again, pulled it about, tasted it again, and finally rubbed his fingers on the ground and left it still fluttering.

(*Note.*—M_2's repeated efforts to eat this butterfly and the rubbing of his fingers on the ground after handling it speak eloquently for its distastefulness.)

Series ε. *Obs.* 684–703. *March* 2.—In the afternoon, M_2 not having had any insects for some days, as I had been away—

Obs. 684. *Sp.* 314.—Carabid, *Tefflus* sp.: a very large, all-black ground-beetle. M_2 watched it run about with great intentness; as it came near he put out a hand and leapt back high in the air. This he did a second time, and then climbed up on to his perch and sat there, obviously unwilling to tackle this formidable insect.

Obs. 685. *Sp.* 315.—Carabid, *Polyhirma* sp.: of same general type as 25, but with anterior half of elytra rusty black: a single median longitudinal whitish mark anteriorly, and two oblique whitish marks posteriorly. M_2 at first treated this like the last, though it was considerably smaller, but, becoming bolder, in one of his leaps he put out a paw and came down heavily on top of the beetle, partly crushing it and causing the abdominal viscera to protrude. M_2 pawed the beetle about a little more and then rapidly bit off the head and thorax, but could not tackle the abdomen, which, after being licked and pawed, was left.

Obs. 686. *Sp.* 316.—Meloid, *Nemognatha caerulans*, Fairm.: a small beetle which exposes itself freely on composite flower-heads; the head and elytra green, thorax orange. M_2 pulled it about, put it up to his mouth, pulled it to pieces, and tasted it in great doubt, then rubbed the remains on the ground.

Obs. 687. *Sp.* 22.—Acridiid, *Dictyophorus productus:* this grasshopper was pulled about; a piece of the abdomen was bitten off and spat out; then it was pulled to pieces, the pieces being tasted and spat out. M_2 was obviously hungry for insects, but could not stomach this aposematic species.

Obs. 688. *Sp.* 186.—Two staple Acridians (*Catantops decoratus*) eaten with great relish after a little examination, and a third was eaten after being pulled about.

Obs. 689. *Sp.* 317.—Buprestid, *Steraspis* sp., not in Br. Mus.: same sp. as 183, but more green than bronze. It shows a conspicuous transverse pale abdominal band when flying. M_2 took it at once, cracked it, pulled off the elytra, nibbled the head, looked again at it, then licked the abdominal viscera which protruded, and finally ate the whole beetle.

Obs. 690. *Sp.* 86.—Lycid, *Chlamydolycus trabeatus:* M_2 touched this insect, scratched himself vigorously, pulled off one of the elytra, and finally, to my surprise, ate the beetle.

Obs. 691. *Sp.* 318.—Reduviid: a long-limbed, rather slender, black bug, speckled with yellow. M_2 held it in his hand for such a long while that it pricked him with its proboscis; he very suddenly gave a start and popped it into his mouth and ate it; subsequently rubbing his hand.

Obs. 692. *Sp.* 308.—Curculionid, *Lixus* sp.: a large weevil with yellow bloom. Eaten at once with relish.

Obs. 693. *Sp.* 319.—Curculionid, *Lixus gracilis* Boh.: of same type as 308, but smaller and more slender. Eaten at once with relish.

Obs. 694. *Sp.* 320.—Cassidid, *Aspidomorpha tecta* Boh.: a typical "tortoise-beetle" with the pattern marked in bright gold, the remainder of the elytra transparent. It was eaten at once without any sign of dislike.

Obs. 695. *Sp.* 235.—Carabid, *Eccoptoptera cupricollis:* M_2 at first treated this as very objectionable, leaping into the air and coming down on to the beetle with one paw. He then took it in one hand, rubbed it with the other, quickly bit off the head and thorax, and ate it with relish. It was a ♂—differing from the

♀ in having a median, single, whitish, linear mark anteriorly instead of the two spots of the ♀.

(*Note.*—This species appears to have lost the typical foul odour of a Carabid beetle—and its resemblance to a *Mutilla* would seem to be Pseudaposematic, or Batesian mimicry. I was unable to make another specimen emit any smell whatever, under pressure. The monkey at first regarded it as highly objectionable, but having tasted it, afterwards ate it with relish.)

Obs. 696. *Sp.* 308.—Curculionid, *Lixus* sp.: two eaten with relish.

Obs. 697. *Sp.* 322.—A bug (probably a Pentatomid): medium-sized, shiny grey-black dappled with orange. M_2 took it in a very lackadaisical manner and pulled off the tegmina, thus revealing the red upper surface of the abdomen. He then pulled the bug about and ate it without any definite sign of dislike.

Obs. 698. *Sp.* 323.—Lymantrid, *Leucoma* sp. near *atricosta* Hmpsn.: a pure white moth, the wings thinly scaled, with a black spot on the fore-wing. The wings of one side having been cut off for record, it was allowed to flutter on the ground. M. watched it for a long time, and at last put out a hand and touched it. The moth at once ceased fluttering and lay quite still with the tip of the abdomen strongly curved ventrally. M. took it by one wing, smelt it and dropped it.

Obs. 699. *Sp.* 324.—Acraeine, *Acraea terpsichore* L., f. *rougeti* Guér.: a very common, small, black and orange-brown butterfly. The wings of one side were cut off. M. pulled off the other wings, put the body into his mouth and ate it. He sat absolutely still while eating it, in a curious stiff posture and with a doubtful, serious face, almost as if he was wondering whether he was going to be sick! In fact I couldn't make out why he ate it, as he got no enjoyment from it!

Obs. 700. *Sp.* 325.—Phytophaga: grey-brown beetle, streaked with blackish-grey; rotund, procryptic. Found hiding on the under-surface of a leaf. M. handled it without much interest, tasted it, then ate with apparent pleasure.

(*Note.*—I came across very few procryptic

Phytophaga during these experiments, and it is interesting that this one seemed edible.)

Obs. 701. *Sp.* 326.—Tenebrionid, *Sepidium muscosum* Gerst.: of same type as 46, but of a more uniform earth-colour and much more bristly. M_2 took it, felt it, put it up to his mouth, held it in one hand and rubbed it with the other as if to try and get the bristles off, then bit off the head and dropped the remainder.

Obs. 702. *Sp.* 308.—Curculionid, *Lixus* sp.: this weevil was eaten with relish.

Obs. 703. *Sp.* 186.—Acridiid, *Catantops decoratus:* several of these favourite grasshoppers were offered in a box, but M_2 only ate one and that not eagerly. He was presumably satisfied by the numerous insects he had eaten.

Series ζ. *Obs.* 704–733. *March* 4, 2.30 *p.m.*—M_2 had been asleep, but was quite ready for insect food.

Obs. 704. *Sp.* 327.—Drilid: a beetle larva, about 2½ inches long, red-brown and black, bristly. Found crawling on the ground. M_2 watched it from a distance with great interest, and kept coming to look more closely at it and then running away, but showed no desire to touch it.

Obs. 712. *Sp.* 329.—Cetoniid, *Protaetia carneola* Burm.: a small procryptic beetle, dark brown mottled with black and dark grey. Offered to M_2, who took it after looking at it, but suddenly put it down in a great panic and ran away. The beetle *may* have bitten him, but apparently it kept motionless. I offered it again and the monkey took it, smelt it, and threw it down.

Obs. 718. *Sp.* 170.—Pierine, *Mylothris agathina:* a ♀, offered in my fingers. M_2 was not at all eager to take it, and allowed it to fly away. I re-offered the butterfly; M_2 grabbed it, put it down and danced on it as if it were a formidable Carabid (see *Obs.* 685, 695), then pulled off the wings, but did not taste it. After a little he went back to it, pulled it about, pawed it, and pulled off the abdomen, which he put in his mouth, but did not appear to like. He did not eat the rest. He afterwards ate three *Lixus* weevils, and a ground-weevil.

Obs. 725. *Sp.* 332.—Cassidid: a pupa, about half an inch long, black, spiny. Offered on the leaf to which it was affixed conspicuously. M_2 was much more interested in the leaf, but smelt, handled, nibbled the pupa and discarded it.

(*Note.*—This observation is particularly interesting because, unlike M_1, M_2 had previously eaten *all* the Cassidid beetles offered to him. This pupa belonged to a large species, probably 251.)

Obs. 728. *Sp.* 334.—Lymantrid, *Arctornis* (*Euproctis*) *producta* Wlk.: a pure white moth with the black tip of the abdomen surrounded by yellow hairs as in our "gold-tail." Offered at rest in a box. M_2 looked very closely at it and licked a wing, whereat the moth protruded the tip of the abdomen dorsalwards between the edges of the wings. M_2 again put his mouth close down, but I could not see whether he licked the moth again. He pawed it on the ground and left it.

(*Note.*—Compare the behaviour of the Zygaenid, *Obs.* 639.)

Series η. *Obs.* 734–765. *March* 7.

Series θ. *Obs.* 766–787. *March* 10, at 2.30 p.m.: M_2 quite ready for insects.

Obs. 766. *Sp.* 350.—Mantid: a young green specimen. It was offered to M_2, who to my intense surprise looked at it as if not knowing what it was. He then pulled it about, tasted it, and left it. Afterwards he came back to it and ate the pieces.

(*Note.*—It is likely that this was the first mantis that this young monkey had ever seen, for he had been a captive from extreme babyhood. It is worth comparing this observation with 26, when M_1 first met the big mantis of which he subsequently ate numbers.)

Obs. 774. *Sp.* 351.—Noctuid larva: a leaf-green, extremely procryptic caterpillar. M_2 took it and held it wriggling in his hand for a long while. I feel quite sure he had not seen one before, as I had never taken caterpillars to him. He then bit off half and ate it with great satisfaction, afterwards eating the rest and licking up from off the ground a large drop of the visceral contents which had exuded.

Obs. 782. *Sp.* 357.—Chrysomelid: a small, compact, inconspicuous brown and black beetle, but it exposes itself like a conspicuous species. Being small M_2 put it into his mouth without adequate inspection; he afterwards pulled it out and threw it away.

(*Note.*—Although not conspicuous in colouring this little beetle appeared to be distasteful. But its habit of freely exposing itself is that of a distasteful species; its colouring is such that variation might easily make it conspicuous. One can quite well conceive that aposematic colours might be developed thus.)

Series ι. Obs. 788–809. *March* 15, at 3 p.m.

Obs. 789. *Sp.* 359.—Acridiid: rather a large grasshopper, very procryptic, dark mottled grey, showing when it flies conspicuous yellow, black-bordered wings. M_2 bit off its head, then pulled it about a good deal, pulling off the yellow wings after looking at it much, finally eating it.

(*Note.*—Compare notes on the coloured wings of Acridians given previously.)

Obs. 793. *Sp.* 361.—Buprestid, *Sternocera laevigata* Kolbe: only one specimen, the type, in the British Museum. A large beetle, head and thorax black, elytra shining light brown, quite conspicuous. M_2 was eager to take it, but found it extremely hard. After several attempts to break it up, he put it down almost in despair, but at length managed to extract the soft parts, which he ate with satisfaction.

Obs. 799. *Sp.* 366.—Longicornia: a medium-sized, dark-brown, beautifully procryptic Longicorn beetle. It was offered to M_2 on my finger; it lay as if dead and he took it as if not quite sure what it was, and put it down. Eventually he took it up, looked at it again, and ate it with gusto.

(*Note.*—Seeing that even when the beetle was seen out of its natural surroundings the monkey did not at first seem at all certain what it was, it is probable that when in its natural haunts the beetle would often escape being eaten.)

Series κ. Obs. 810–836. *March* 18, at 10.30 a.m., M_2 quite ready for insects.

Obs. 816. *Sp.* 174.—Pierine, *Catopsilia florella:* a ♀ was offered, but though M_2 took it willingly he allowed it to escape untasted.

Obs. 817. *Sp.* 313.—Pierine, *Herpaenia eriphia:* M_2 danced on this butterfly, as he did with *Mylothris* *agathina* (Obs. 718), and pawed it, but would not taste it. It is a pale yellow species, barred with black, procryptic beneath.

Obs. 818. *Sp.* 172.—Pierine, *Belenois mesentina:* this butterfly was pawed about, and rubbed on the ground; M_2 eventually pulled off the wings and put the body into his mouth, but, to my surprise, took it out again.

(*Note.*—M_2 differs much from M_1 in his opinion of this butterfly. See Obs. 510.)

Obs. 819. *Sp.* 141.—Acraeine, *Acraea neobule* Dbl.: a semi-transparent red species. M_2 seized this butterfly and put it up to his mouth, took it out and looked at it, bit off the head, then put the insect down and left it alone.

(*Note.*—It did not appear as if the monkey recognised this *Acraea* at first sight as distasteful.)

Obs. 820. *Sp.* 171.—Nymphaline, *Precis antilope* (= *simia*)*:* M_2 carefully pulled off the wings of this butterfly and ate the body with relish.

Obs. 821. *Sp.* 370.—Locustid: a short, fat-bodied, grass-green grasshopper not in the Br. Mus.; an adult winged specimen. Found among grass, where I should never have seen it unless it had betrayed itself by a movement. When I put it before M_2 he seemed at first very eager for it, but when it crawled within reach he took it and pulled off each hind leg in turn, tasting them. He then pulled out the viscera and put them in his mouth, but afterwards ejected them, and left the rest uneaten.

(*Note.*—This insect being so procryptic might have been expected to be edible, but this group of fat-bodied Locustids as a whole seems to be distasteful, in spite of the procrypsis.)

Obs. 822. *Sp.* 308.—Curculionid: two staple weevils (*Lixus*) eaten eagerly.

Obs. 823. *Sp.* 371.—Nymphaline, *Atella phalantha:* a very abundant butterfly, of a "Fritillary" appearance. M_2 appeared very eager for this, apparently not knowing it. He pulled off the wings, put the body straight into his mouth, and spat it out.

Obs. 824. *Sp.* 172.—Pierine, *Belenois mesentina:* M_2 pulled off the wings of this butterfly, put the body into his mouth, pulled it out, put it in again, and at last swallowed it after much mouthing.

(*Note.*—Again M_2 showed strong contrast with M_1 in his opinion of this butterfly.)

Obs. 825. *Sp.* 352.—Lycid, *Lycus ampliatus:* the wings and elytra of this beetle were pulled off, the body put up to mouth, then put down.

After these observations M_2 ate 18 insects of various kinds.

Series λ. *Obs.* 837–868. *March* 20. At 3 p.m. M_2 did not seem very eager at first, but later became so.

Obs. 841. *Sp.* 52.—Lamiid, *Dirphya similis:* a ♀. M_2 violently rubbed and pawed this Longicorn on the ground and pulled it about, holding it down by the antennae and pawing the body with his other hand. At length he studied it with great interest, gingerly tasted it several times, and finally ate it with gusto.

(*Note.*—M_2 behaved to this beetle as if it were pseudaposematic; M_1 (Obs. 98, 99) treated it as though synaposematic (see pp. 92, 93, 99).

Obs. 842. *Sp.* 350.—Though this mantis was only half grown, M_2 seemed quite afraid of its forelegs. He picked it up at once and ate the abdomen; the thorax with the struggling forelegs lay on the ground, and M_2 violently rubbed them on the ground before eating the whole with gusto.

Obs. 857. *Sp.* 381.—Longicornia: a Longicorn beetle, dull black with three narrow transverse bands and other markings of dull rose colour, somewhat aposematic. M_2 seemed to recognise the typical shape of the Longicorn and was very eager for it at first, but apparently had not seen its colours. For when I put it on the ground it fell on its back, and he at once took it and bit off its head and thorax. He then looked at it in surprise, took the rest of it up to his perch, where he pulled it to pieces, tasted it, but left most of it uneaten.

Obs. 862. *Sp.* 283.—Lampyrid: M_2 picked up this beetle larva, bit off the end of the abdomen, then put down the larva in surprise, looked at it (*which he had not done before*) and left it.

(*Note.*—The careful attention paid to this black and pink larva after it had been found to be inedible suggests very strongly that the monkey was "learning it." Cp. Obs. 857.)

Series μ. *Obs.* 869–901. *March* 25. At 2 p.m. M_2 very hungry for insects.

Obs. 874. *Sp.* 382.—Asilid: a fly of which the ♀ has a strong resemblance to a small brown bee; the ♂ is black. I offered M. a ♂, which he took from the forceps and ate without hesitation: I then offered the bee-like ♀, which M_2 took and hurriedly bit, as if he was afraid of it; he then looked at it in surprise and ate the rest of it in a more leisurely manner.

(*Note.*—It was very difficult to avoid the conclusion that the monkey thought the ♀ fly was something else than it was. He had eaten the ♂ without hesitation, and after he had found the ♀ innocuous, he ate it also. It appears to be a case of Batesian mimicry.)

Series ν. *Obs.* 902–914. *March* 28. At 10.30 a.m. M_2 squealing with eagerness.

Obs. 913. *Sp.* 391.—? Clerid: a beautiful mimic of a *Mutilla*, about ½-inch long, rather cylindrical in shape; dull red anteriorly, black with white marks posteriorly. The beetle has short antennae, which it vibrates rapidly, exactly as does a *Mutilla*.

I found it on the tip of a grass stem. When it was put on the ground in front of M_2, he treated it exactly as he and M_1 had treated Mutillids, and at once pawed it on the ground, throwing it about. I then tried to get it again for record, but the monkey seized it and very quickly put it into his mouth and crunched it up rapidly, as he would a *Mutilla*. But he afterwards spat it out again. The resemblance therefore seems to be synaposematic. After this experiment M_2 ate 8 weevils (*Isaniris* sp.).

SECTION IV

ORTHOPTERA.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
201	739	**Forficulidae.** *Forficula senegalensis* Serv.	C	⊜	⊜	M_2 agreed with M_1 about this earwig.
350	766, 842	**Mantidae.** ?	PP	±		Young green specimens.

Remarks on MANTIDAE.

M_2 was not nearly so eager for young mantis as M_1 had been. Unfortunately Mantids were not so abundant at this time as when M_1 was used, but I believe the above indication was a true one of M_2's attitude towards them. It would have been very interesting to test him with Sp. 19.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Acridiidae.				
22	653, 687, 772	*Dictyophorus productus* Bol.	AA	– –	– –	M_2 agreed with M_1.
186	Numerous	*Catantops decoratus* Gerst.	P	++	++	Used as staple food.
359	789	?	PP	±		Dark grey; yellow wings bordered black.
369	810	?	PP	++		Green and brown; yellow wings bordered black.
		Locustidae (Tettigoniidae).				
176	644, 711, 853	*Gymnoproctus* sp., immature.	P	⊜	⊜	M_2 agreed with M_1.
267	672, 815	*Poecilogramma* sp.	A	±	– –	Both monkeys classed it as distasteful.
293	628, 714	Immature.	A	–		Short, fat, black and dull orange.
301	657	,,	PP	±		Grass-green.
302	658	,,	PP	– – –		Grass-green, legs darker.
303	659	?	PP	– – –		Grass-green, adult.
370	821	Species not in Br. Mus.	PP	–		Grass-green, adult, large.
384	881	*Poecilogramma striatipennis* Karsch.	A	±		Dull purple, yellow and black.

General remarks on the LOCUSTIDAE (TETTIGONIIDAE).

M_2 was more decisive than M_1 about the distastefulness of *all* Locustids offered him, although some were exceedingly procryptic. As with the experiments on M_1, all the species were of the type with short fat bodies. The remarks on the experiments with M_1 should be borne in mind.

HYMENOPTERA.

		Formicidae.				
53	732	*Megaponera foetens* (cocoons).		++	++	M_2 agreed with M_1.

COLEOPTERA.

		Scarabaeidea. **Cetoniidae.**				
153	667	*Leucocelis haemorrhoidalis* F.	AA	–	– – –	Classed as distasteful by M_1 and M_2.
329	712	*Protaetia carneola* Burm.	P	– – –		Dark brown, mottled with black and grey.
380	852	*Tetragonorrhina induta* Jans.	P	– – –		Dark grey, hairy.

Remarks on the CETONIIDAE.

M_2 agreed with M_1 that these are distasteful, although two were procryptic.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Melolonthidae.				
368	804, 891	*Eriesthis* sp.	P	+		
		Trogidae.				
231	893	*Trox incultus* Boh.	P	±	— —	Classed as distasteful by M_1 and M_2.
		Caraboidea. **Carabidae.**				
235	695	*Eccoptoptera cupricollis* Chaud.	AA	⊕	⊕	Treated alike by M_1 and M_2.
294	630	?	A	+		Small, black.
314	684	*Tefflus* sp. (? same as 177)	A	(≡)		Very large, black. Possibly same as 177 and treated like it.
315	685	*Polyhirma* sp.	A	⊜		Black with dull white marks.
347	759	?	C	— —		Small, black and yellow-brown.
365	797	Prob. *Parachlaenius* sp., possibly *emini* Kolbe.	A	(≡)		Medium size, very active, blue-black, termite-haunting.
387	905	*Harpalus* sp.	A	⊜		Black, dark brown legs.

Remarks on the CARABIDAE.

M_2 agreed with M_1 as to the distastefulness of ground-beetles, classing all as minus with two exceptions. One of these was small, the other was a mimic of Mutillids, and both monkeys appear to have taken it at first for the model and rubbed it on the ground, subsequently finding it good to eat. As was pointed out before, this beetle seems to have lost the typical Carabid odour.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Polymorpha. **Coccinellidae.**				
98	660, 806	*Epilachna chrysomelina* F.	A	—	— —	M_2 seemed to find these a shade less disagreeable than M_1.
254	629	*Epilachna paykulli*, Muls.	A	+	±	
		Malacodermidae. **Lycidae.**				
86	621, 690, 715, 746	*Chlamydolycus trabeatus* Guér.	AA	±	— — —	
352	776, 825	*Lycus ampliatus* F.	AA	—		
378	843	*Lopholycus amoenus* Bourg.	AA	— — —		
385	892	?	AA	—		
		Drilidae.				
327	704	Larva.	AA	— — —		Orange with black patches. Large and conspicuous.
		Lampyridae.				
283	862	Larva.	A	— — —		M_2 agreed with M_1.

Remarks on the MALACODERMIDAE.

M_2 seemed to agree with M_1 as to the distastefulness of these beetles and their larvae.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Melyridae.				
63	791	Gen. nr. *Prionocerus*	AA	— — —	— — —	M_2 agreed with M_1.
		Cleridae.				
391	913	?	AA	⊖		A Mutilloid species (probably synaposematic).
		Buprestidae.				
242	643, 764	*Sphenoptera disjuncta* Fåhr.	P	+ +	+ +	M_2 agreed with M_1.
317	689	*Steraspis* sp., not in Br. Mus.	C	+		Dull green; shows white band (? aposematic) across abdomen when flying.
361	793	*Sternocera laevigata* Kolbe.	AA	+		Very large and hard, black and light brown.
342	751	?	AA	+		Black, large white marks on elytra, thorax edged green.
376	830	?	P	+ +		Bronze, about ¾ in. long.

Remarks on the BUPRESTIDAE.

Like M_1, M_2 seemed to find these beetles edible, in spite of aposematic colouring in some species. But, as in Obs. 793, their hardness will probably save them in cases when the monkey is not hungry enough to tackle the job of cracking them.

		Heteromera. **Tenebrionidae.**				
13	617	*Macropoda transversalis* Kolbe.	A	—	±	
36	783	*Lamprobothris fossulata* Müll.	*a*	⊜	— —	M_2 agreed with M_1.
69	709	*Rhytinota gracilis* Gerst.	A	+ +	±	? more experiments required.
215	635, 740, 801, 902	*Catamerus revoili* Fairm.	AA	—	⊜	Treated as distasteful by both monkeys.
326	701	*Sepidium muscosum* Gerst.	PP	—		Cp. M_1 with 46, which this generally resembles.
372	826, 861	*Paramarygmus metallicus* Fairm.	C	—		Rotund, dull bronze, polished.
156	851	Larvae, possibly of 215.	A	— — —	—	M_2 classed this as more distasteful than did M_1.

Remarks on TENEBRIONIDAE.

M_2 only ate one of these, but only a single experiment was performed with it. The other species, and larvae, were classed as inedible, and the two monkeys agreed about the distasteful qualities of these beetles.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Meloidae.				
316	686, 710, 773, 911	*Nemognatha* sp. ? *coerulans* Fairm.	AA	— —		Small: head and elytra green, thorax orange.
328	705, 869	*Mylabris praestans* Gerst.	AA	⊜		Very large, black and lemon yellow.
330	720	*Mylabris bipartita* Gerst.	AA	— —		Large, orange and black.
362	794, 872, 895	*Zonitis* sp.	AA	—		Active, slender, bright red with black limbs, synaposematic with some Phytophaga.

Remarks on the MELOIDAE.

M_2 agreed with M_1 about the qualities of these typically aposematic beetles, classing all as distasteful, though he was a little more ready to examine them than M_1. No. 362 belongs to a synaposematic group.

		Phytophaga. **Sagridae.**				
344	755	?	AA	+		Like 197, but smaller. ? male.
		Megalopidae.				
195	640	*Poecilomorpha apicata* Fairm.	AA	— —	— — —	Treated as distasteful by both monkeys.
		Crioceridae.				
292	625, 631, 854	?	AA	—		Orange with black limbs, one of a synaposematic group.
		Clytridae.				
271	670, 861, 866	*Tituboca sansibarica* Lefevr.	A	—	—	M_2 agreed with M_1.
272	855	*Diapromorpha (Peploptera)* sp. nr. *curvilinea* Jac.	*a*	—	— — —	Treated as distasteful by both monkeys.
		Eumolpidae.				
188	624	*Euryope batesi* Jac.	AA	— —	⊖	Treated as distasteful by both monkeys.
193	754	*Corynodes usambicus* Klb.	A	—	±	Treated as distasteful by both monkeys.
216	627, 707	*Corynodes raffrayi* Lefevr.	AA	—	⊜	Treated as distasteful by both monkeys.
309	671, 784	*Pseudocolaspis* sp. nr. *sericata* Marsh.	P	+		Dull bronze dusted with grey powder.

Remarks on the EUMOLPIDAE.

Like M_1, M_2 treated these beetles as distasteful, except one species which was procryptic.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Chrysomelidae.				
217	626, 727	*Chrysomela* sp.	*a*	– –	– – –	Treated as distasteful by both monkeys.
348	761	*Chrysomela opulenta* Reiche.	C	–		Rotund, dull bronze.
357	782	?	*a*	–		Brown and black.
		Halticidae.				
386	899	*Polyclada* (*Diamphidia*) sp. nr. *pectinicornis* Oliv.	P	– – –		Large, greenish-grey, brown spots.
		Galerucidae.				
54	716	*Diacantha conifera* Fairm.	AA	–	– – –	Treated as distasteful by both monkeys.
354	779, 808, 910	*Aenidia* sp.	A	– – –		Bright green, gregarious, active.
		Cassididae.				
38	763, 890	*Aspidomorpha hybrida* Boh.	A	+ +	– –	Bronzy green.
280	661	?	A	+ +	– – –	Fiery orange-pink, black spots.
320	694, 786	*Aspidomorpha tecta* Boh.	A	±		Tortoise pattern bright gold or fiery orange.
338	743, 865, 896	*Aspidomorpha hybrida* Boh.	P	+ +		Variety of 38, grey-green and procryptic.
355	780, 785, 800, 805	*Aspidomorpha quadrimaculata* Oliv.	P	±		Translucent grey variety: cp. 251 (M_1).
332	725	Pupa, probably of 355.	AA	– –		Black and spiny.
340	745	?	PP	+		Rough, dead leaf brown.

Remarks on CASSIDIDAE.

M_2 showed himself much more agreeably disposed towards this family than did M_1, which is very interesting. Certain species of procryptic hue turned out to be the same as some which had been classed as aposematic when offered to M_1—the coloration being somewhat different.

		Phytophaga (family unknown).				
304	663	? possibly *Chrysomela.*	AA	+		Black with orange thorax, rotund.
325	700	? ,, ,,	P	+		Grey-brown, streaked blackish, rotund.
		Longicornia.				
		Cerambycidae.				
244	641, 666, 775, 876	*Anubis* (*Oligosmerus*) *limbalis* Har.	C	+ +	+	Treated as quite edible by both monkeys in spite of the odour.
296	646	*Phyllocnema* sp.	AA	–		Dark blue and yellow brown with the aromatic odour well marked.
		Lamiidae.				
300	656	*Ceroplesis malepicta* Fairm.	AA	–		Black with red bands.
52	841	*Dirphya similis* Gah.	AA	+	–	The monkeys were not in accord.
		? Family.				
307	668	?	PP	+		Bark-colour.
333	726	?	P	+ +		Dull reddish, powdered black.
337	742	?	PP	+ +		Small, slender, brown.
366	799	?	PP	+		Bark-brown.
381	857	?	A	–		Dull black with pink bands.

Remarks on the LONGICORNIA.

With one exception the aposematic species were treated as inedible, the procryptic were eaten. The exception is a mimic of Braconids, and the resemblance *may* be pseudaposematic, but the same species did not seem edible to M_1.

The common species 244, bright shining green, is rather difficult to class as regards its coloration (see notes on M_1). Both monkeys found it edible in spite of its odour.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Curculionidae.				
97	623, etc.	*Isaniris* sp., probably new.	P	++	++	Used as staple food.
221	729	*Microcerus spiniger* Gerst.	C	+	±	
252	828	*Blosyrus haroldi* Hartm.	PP	++	++	M_2 agreed with M_1.
306	665	*Mitophorus* sp.	P	++		Dull black, dull yellow lateral line.
308	669, etc.	*Lixus* sp.	P	++		Large, grey with yellow bloom: used as staple food.
319	693, 731	*Lixus gracilis* Boh.	P	++		Like 308, smaller, more slender.
331	724	?	PP	++		Rough, stony grey.
353	778	?	PP	++		Large, dark brown, white network.
356	781	?	PP	++		Dark brown.
364	796	?	PP	++		Stony grey.
377	838	*Larinus* sp.	P	++		General resemblance to 308, but smaller.

Remarks on the CURCULIONIDAE.

All the weevils offered to M_2 were procryptic except one, and all were greedily eaten. The two monkeys were quite in accord as to the edibility of this family.

		Rhopalocera. **Danaidae.**				
286B	676	*Danaida chrysippus* L., f. *dorippus* Klug.	AA	–	±	M_2 treated this as more distasteful than did M_1.
		Acraeidae.				
104	886	*Acraea caldarena* Hew., f. *neluska* Oberth.	AA	– –	– –	M_2 agreed with M_1.
141	682, 819	*Acraea neobule* Dbl.-Hew.	AA	– –	–	M_2 treated this as more distasteful than did M_1.
324	699, 878	*Acraea terpsichore* L., f. *rougeti* Guér.	AA	+		

Remarks on the above butterflies.

M_2 caused some surprise by finding No. 324 not unpleasant, but agreed with M_1 as to the distastefulness of the other aposematic species offered him.

LEPIDOPTERA.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Nymphalidae.				
80	832, 888	*Precis clelia* Cram.	P	++	?	
93	677, 717, 833	*Precis cebrene* Trim.	P	±	++	M_2 treated this as less edible than did M_1.
171	820, 867	*Precis antilope* Feisth. ⊗ = *simia* Wallgrn.	A	++	+	This species was treated as edible by both.
173	897	*Precis natalica* Feld.	P	±	++	M_2 treated this as less edible than did M_1.
120	636, 839	*Hypolimnas misippus* L., ♀	AA	–	±	Both treated this as distasteful.
371	823	*Atella phalantha* Dr.	A	–		Orange brown with black spots.
345	757	*Byblia goetzius* Herbst.	P	– – –		M_2 found this procryptic species not at all to his liking.

Remarks on above NYMPHALIDAE.

M_2 showed some difference of opinion from M_1; it is of interest that both treated *misippus* ♀ (mimetic) as distasteful. This strengthens the view that it is a Müllerian mimic (synaposematic).

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Pieridae.				
103	748, 884	*Terias senegalensis* Boisd.	P	+	+	M_2 agreed with M_1.
212	846, 859, 883	*Teracolus eris* Klug.	P	++	++	,, ,, ,,
298	651	*Teracolus eupompe* Klug.	P	+		White with crimson tips.
312	680	*Teracolus evarne* Klug.	P	–		Yellow, orange-tipped: like *Eronia leda.*
313	681, 817, 840	*Herpaenia eriphia* Godt.	P	±		Pale yellow, barred black.
170	718, 722, 734	*Mylothris agathina* Cram.	AA	⊜	±	Classed as distasteful by both monkeys.
142	749, 831	*Pinacopteryx simana* Hopff.	P	++	++	M_2 agreed with M_1.
172	760, 818, 824, 849, 889	*Belenois mesentina* Cram.	P	– –	++	M_2 differed widely from M_1.
174	650, 735, 816, 877, 894	*Catopsilia florella* Fabr.	P	–	±	Classed as distasteful by both monkeys.
264	648, 674, 723, 736	*Eronia cleodora* Hübn.	PP	–	±	,, ,, ,,

Remarks on PIERIDAE.

The majority of the species dealt with, classed by the colours of the under-surface, are procryptic. The only aposematic species (No. 170) was treated by M_2 as highly objectionable, and also by M_1 as distasteful. It is curious that the extremely procryptic *Eronia cleodora*, No. 264, was found distasteful by both monkeys: the very abundant near ally, No. 174, was also classed as distasteful: perhaps this section of the Pieridae as a whole may have inherited a distasteful quality not lost by some of the most procryptic members. It is also noteworthy that *Teracolus evarne*, which resembles *Eronia leda*, seemed to be somewhat distasteful. M_2 differed very widely from M_1 as to the edibility of *Belenois mesentina*.

In a letter to Professor Poulton received in June 1917 from Kibwezi, Mr. W. Feather says—"I have also been feeding a couple of monkeys with butterflies. They will occasionally eat the abdomen of *Danaida chrysippus dorippus* Klug. Acraeas and *Tirumala petiverana* they do not attempt to eat; the smell is quite sufficient. *Teracolus*, *Terias*, *Belenois* and *Precis* they eat without the least hesitation."

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Papilionidae.				
311	679	*Papilio demodocus* Esp.	A	—		Black and lemon yellow: under surface like upper.
		Hesperidae.				
297	649, 860	*Leucochitonea hindei* Druce.	C	±		Black and white: much like a Pierine.
383	880	*Rhopalocampta pisistratus* F.	P	+		Yellow-brown, large.
		Heterocera. **Zygaenidae.**				
262	639, 719	*Neurosymploca xanthosoma* Jord.	AA	— —	—	M_2 agreed with M_1.
		Lymantridae.				
323	698	*Leucoma* sp. nr. *atricosta* Hmpsn.	AA	— —		Pure white.
334	728	*Arctornis* (*Euproctis*) *producta* Wlk.	AA	⊜		Pure white: tip of abdomen black with yellow bristles.

Remarks on these moths.

All three highly aposematic species were classed as very distasteful.

		Noctuidae.				
351	774	Larva.	PP	+		Smooth leaf-green caterpillar.
		DIPTERA.				
		Asilidae.				
67	620, 673	*Hoplistomerus serripes* F.	A	+	— — —	
382	874	?	A	+		♀ resembles a honey-bee, ♂ black.

Remarks on the ASILIDAE.

No. 67 so closely resembles a Hymenopterous insect that M_1 would not even catch hold of it. M_2, however, ate it and found it not unpalatable. No. 382 is interesting on account of its mimetic female: M_2 found the black male edible.

There is therefore reason for supposing that the mimetic resemblance of these flies to Hymenoptera is not Müllerian (Synaposematic), but Batesian (Pseudaposematic).

HEMIPTERA.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Heteroptera. **Pentatomidae.**				
41	634	*Callidea bohemani* Stål.	AA	+	– –	Marked difference between M_2 and M_1.
339	744, 798, 847	? same as 41.	AA	±		Blue and gold.
44	616	*Aspongopus viduatus* F.	A	– –	– –	M_2 agreed with M_1.
295	642	? same as 44.	A	±		Shows red abdomen in flight: very odoriferous.
310	675, 850, 863	*Anoplogonius aulicus* Germ., var. *uniformis* Dist.	AA	– –		Shining dark blue and red.
349	762	*Paramecocoris lautus* Stål.	PP	+		Colour of dead grass.
363	795, 858, 873	*Sphaerocoris annulus* F., var. *ocellata* Klug.	P	–		Convex, rotund, odoriferous, black and yellow-green.
375	829, 844, 882	*Caura rufiventris* Germ.	C	⊖		Dark brown
389	907	*Nezara viridula* L.	PP	–		Grass-green, odoriferous.
322	697	?	A	±		Grey-black dappled with orange.
343	752	Larvae.	AA	+		Dark blue, spotted with orange.
367	803	?	P	– – –		Small, grey.

Remarks on the PENTATOMIDAE.

M_2 was less definite about this family than was M_1, and the results from him are irregular: procryptic species were discarded and aposematic specimens eaten. But on the whole the family was classed as more or less distasteful.

Sp. No.	Obs. No.	Name.	Colour.	Edibility. M_2	Edibility. M_1	Remarks.
		Coreidae.				
42	655, 737, 813, 887	*Anoplocnemis curvipes* F.	A	$\textcircled{++}$	$\textcircled{++}$	M_2 agreed with M_1. It is remarkable that both pawed this odoriferous bug on the ground, but ate it with relish.
		Lygaeidae.				
65	792	*Lygaeus* sp., not in Br. Mus.	AA	– – –	– –	Classed as distasteful by both monkeys.
87	619	*Oncopeltus famelicus* F.	AA	– – –	–	Classed as distasteful by both monkeys.
		Pyrrhocoridae.				
222	632	*Roscius illustris* Gerst.	AA	+	–	M_2 differed markedly from M_1.
		Reduviidae.				
305	664	*Phonolibes bimaculatus* Dist., or near it.	A	– – –		Dull black and rose.
341	750	*Vitumnus scenicus* Stål., typical form.	A	⊕		Orange, with dark background.
318	691	?	A	±		Black, speckled with yellow.
		? Family.				
346	758	?	A	+		Black and scarlet.

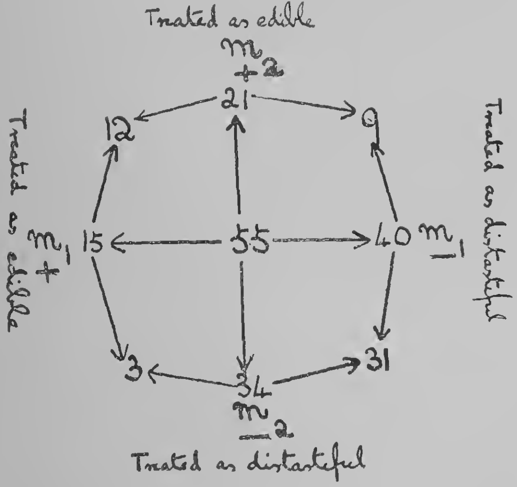
Hemiptera as a whole give more irregular results than other families, and further experiments are much needed. The odour that to us seems so very unpleasant does not appear to be considered a distasteful quality by the monkeys; moreover species were refused that had no perceptible odour. In one family may be found typically aposematic but comparatively odourless species, and extremely odoriferous but highly procryptic species.

Comparison between the two Monkeys.

M_2 seems to have been somewhat less severe in his judgments than M_1, as is shown by considering the fifty-five species offered to both. Of these, forty were put in the same class, *plus* or *minus*, by each monkey. But nine others classed as *plus* by M_2 were put in the *minus* class by M_1, and only three classed as *minus* by M_2 were put in the *plus* class by M_1 (see ring diagram below).

It is of some value to the results of these experiments that the monkeys should have agreed in $\frac{40}{55}$ cases. In quite a number of cases the agreement was exact; these are listed below.

(≡)	– – –	– –	+	+ +	⊕	(++)
2	2	3	1	7	1	1



The ring-diagram brings out well the accord between M_1 and M_2. In all cases where the majority was considered to belong to one class by one monkey, there was also a majority on the same side by the other monkey.

There only remain a few remarks on some general points.

1. *A uniformly black, polished insect is regarded as distasteful.*

Sp. No.	Obs. No.	Name.	Edibility.
21	31, 304	*Hister validus*	(≡)
69	133, 558	*Rhytinota gracilis.*	±
85	176	*Scarites superciliosus.*	– – –
100	212	Carabid larva.	(≡)
140	314, 582	*Diplognatha silicia.*	– – –
166	352	Carabid.	(≡)
225	467	*Rhytinota acuticollis.*	– –

2. *Aposematic species increase their conspicuousness by massing together.*

Sp. No.	Obs. No.	Name.	Edibility.	Colour.
5	217	*Zonocerus elegans.*	– – –	AA
87	615	*Oncopeltus famelicus.*	–	AA
118	256, 258	*Dysdercus superstitiosus.*	±	AA
131	292	Phytophagous larvae.	– –	AA
156	336	Tenebrionid larvae.	–	A
187	388	Pentatomid larvae.	±	A
189	391, 399, 404	Lygaeid larvae.	+	AA
354	779, 808, 910	*Aenidia* sp.	– – –	A

3. *Among the Beetles are Synaposematic groups.*

(*a*) Orange or red with very dark limbs.

292 (*Crioceridae*), 188 (*Eumolpidae*), 216 (*Eumolpidae*), 3 (*Halticidae*), 258 (*Halticidae*), 362 (*Meloidae*).

(*b*) Orange and black (the "Lycoid" coloration).

10, 86, 198, 218, 236, 378 (*Lycidae*), 11 (*Cetoniidae*), 63 (*Melyridae*), 195 (*Megalopidae*), 54 (*Galerucidae*).

Instances of Mimicry.

It has been a matter of great regret to me that the foregoing work has such little bearing on Mimicry, but the material has been very poor; butterflies having been few and not mimetic. There are some cases, however, of mimetic insects, not counting the members of the two synaposematic groups just listed.

1. *The Longicorn beetle* DIRPHYA SIMILIS (No. 52) *mimicking one of the very large Braconids.*

This beetle is slender, and its likeness to the narrow body of the Braconid is accentuated by the disposition of the colours on the sides of the abdomen. Its orange and black colours very closely resemble those of the Braconid, and the antennae and legs in both are long and conspicuous, so that on the wing the beetle may readily be mistaken (Proc. Ent. Soc. Lond., 1918, pp. cxl, cxli). Obs. 98 shows that the monkey M_1, more or less well fed, would have nothing to do with this beetle; indeed he regarded it with extreme dislike. On the next morning, however, before the monkey had eaten anything, he took the beetle and, after examination and tasting, ate it slowly. M_2 treated it at first as very distasteful, but after careful study ate it with appreciation. It is difficult to say whether this is a case of pseudaposematic resemblance (Batesian, or true, mimicry) or of synaposematic resemblance (Müllerian mimicry). The only other aposematic Longicorns I have tested (see Obs. 646, 656, 857) were treated as distasteful. It may be argued that the only three Braconids tested in these experiments are listed as +; but three single experiments all done in sequence will not convince me that the very typically aposematic large Braconids are not distasteful, in light of the evidence of the tables and chart in Section IV!

2. *The Carabid beetle* (235) ECCOPTOPTERA CUPRICOLLIS *mimicking the Mutillid scheme of colour.*

The beetle has dull red head and thorax and black elytra with four white spots. It appears to have lost the characteristic Carabid odour, but has acquired the gait of a *Mutilla.* M_1 appeared very afraid of this (Obs. 484), and pawed it violently, escaping out of reach after each attack, finally picking it up very quickly and hastily crunching it up as he did with those Mutillids that he ate. The fear of this beetle was far greater than it would have been had it been dressed in a normal Carabid livery, since for a medium-sized Carabid it was inoffensive-looking. One cannot avoid the feeling that the Mutilloid appearance accounted for his care not to be hurt by it. M_2 at first also treated this beetle as very objectionable (Obs. 695), but subsequently ate it with relish. Dr. G. A. K. Marshall in his paper on the Bionomics of S. African insects remarked upon the perfection of the mimicry of this beetle (Trans. Ent. Soc. Lond., 1902, pp. 511–2; see also Proc. Ent. Soc. Lond., 1918, p. xcviii).

3. *The butterfly* PAPILIO (COSMODESMUS) LEONIDAS (No. 147) *mimicking the Danaine* TIRUMALA PETIVERANA. Both model and mimic are pale blue with a coarse black pattern.

M_1 held the *Papilio* in his hand and looked at it for a long time, then having tasted it gingerly, ate it without a sign of dislike (Obs. 322). This suggests that M_1 had an instinctive feeling that it was an inedible butterfly, but having tasted and found it good, ate it. This appears to mean that the butterfly is pseudaposematic, but further evidence is required.

4. *The* ASILID *fly* (No. 67) *mimicking a Hymenopterous insect* (SCOLIID).

This large fly has the abdomen covered with golden pubescence, and the wings clouded with brown, both characters giving it, with its wings folded in a position of rest, very much the appearance of a Scoliid. The first one I found was sitting fully exposed on a leaf in the late evening, and I was much struck with its resemblance, which was increased by the suppression of the large bristles so common in Asilids. It was offered to M_1 in a box (Obs. 129); he looked closely at it, but with suspicion. Just as it was about to fly away I caught it by the legs, so that the yellow pubescence of the abdomen was fully visible. M_1 would not catch hold of the fly, although he once put out his hand and gently touched a wing. The fact that on another occasion M_1 took and ate readily another equally large, and bristly member of this family of normal Asilid appearance (Obs. 142) shows that he was not objecting to the first because it was an Asilid. M_2 (Obs. 620, 673) handled the fly equally gingerly, but eventually found it was good to eat. This resemblance to a Hymenopteron would seem to be a case of true Batesian mimicry.

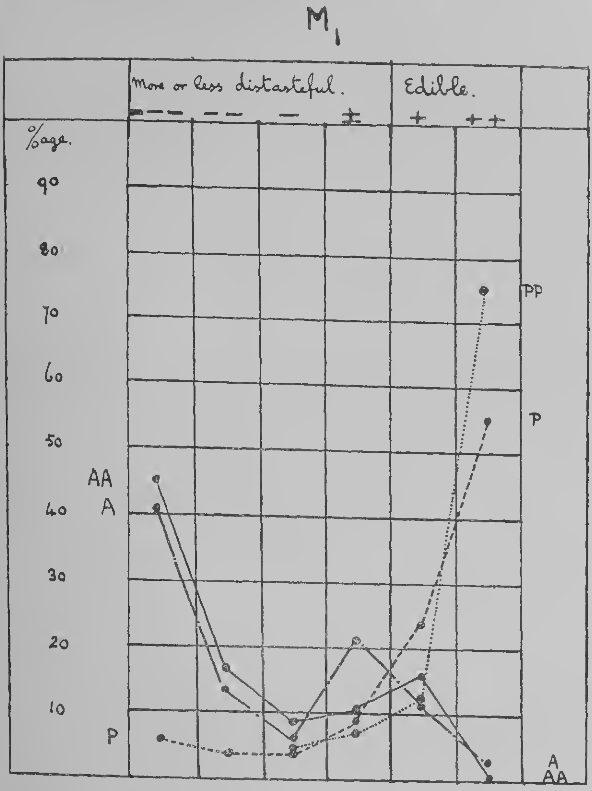
5. *Female Asilid fly* (No. 382) *mimicking a bee.*

The fly is sexually dimorphic, the ♂ being uniformly black, the ♀ brown and bee-like. M_2 ate a male without hesitation, but his behaviour with the female (Obs. 874) left little doubt that he thought it was bee-like.

Since it was eventually eaten with satisfaction the female seems to be pseudaposematic; a case of true mimicry.

6. *Syrphid fly* (ERISTALIS TENAX: No. 61) *mimicking the honey-bee.*

Just as the English honey-bee is closely resembled by *Eristalis tenax*, so is the African form of the same species, and the resemblance is equally striking. In order to test the monkey with this fly, it was necessary to stupefy it so that it was not too ready to take wing, although it would buzz and crawl. Obs. 117, 216, 259 show that M_1 was so much afraid of this fly that on each occasion when, after some doubt, he took it in his hand, he suddenly let it go or threw it down precisely as if it had stung him. It was extremely amusing to see, and suggested that his doubt was so great that when the fly buzzed in his hand he was obliged to let it go for fear of being stung: and Obs. 216 shows that he rubbed it on the ground precisely as he did the model



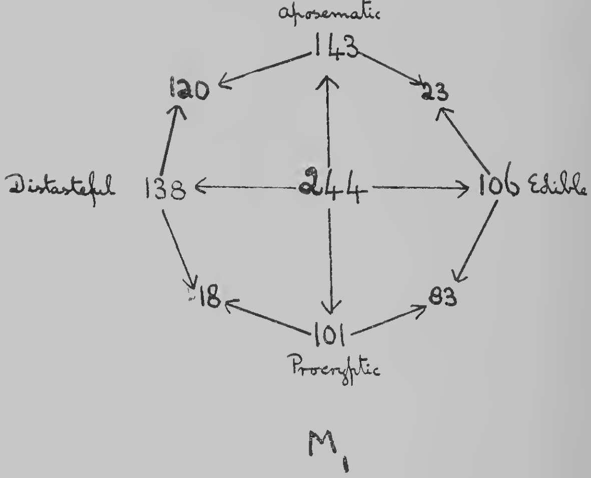
(Obs. 284) which was offered him on the day after the last of the flies.

General remarks on the results.

The foregoing mass of detail in the tables has been summarised for each monkey in the form of a percentage chart and a " ring diagram."

The chart shows for each of the four types of coloration the percentage of each of the six classes of " taste."

In the case of M_1 the practical experimental result could hardly be wished to accord better with the theoretical result that should be obtained if the coloration of the insects has anything to do with their edibility.

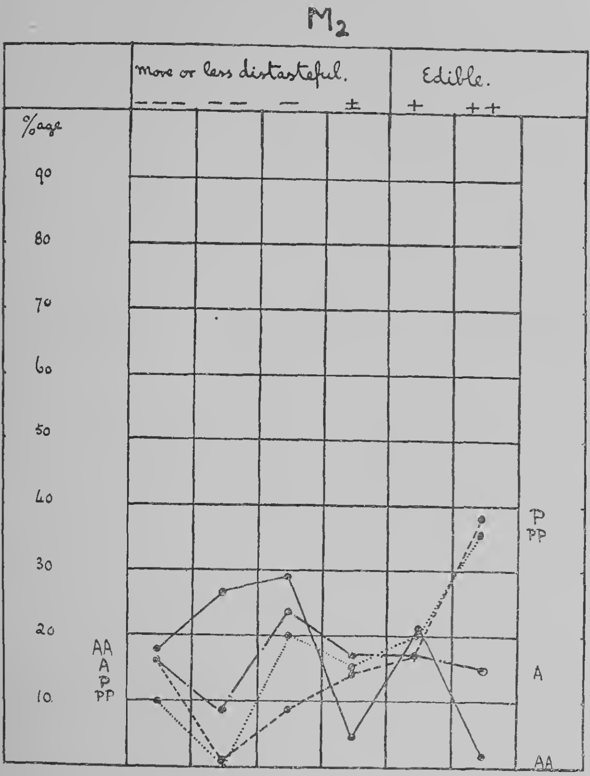


The two curves for aposematic species fall from the *minus* to the *plus* side of the chart, while the procryptic curves, one of which is not represented at all at the extreme end of the *minus* side, rise from the *minus* to the *plus* side.

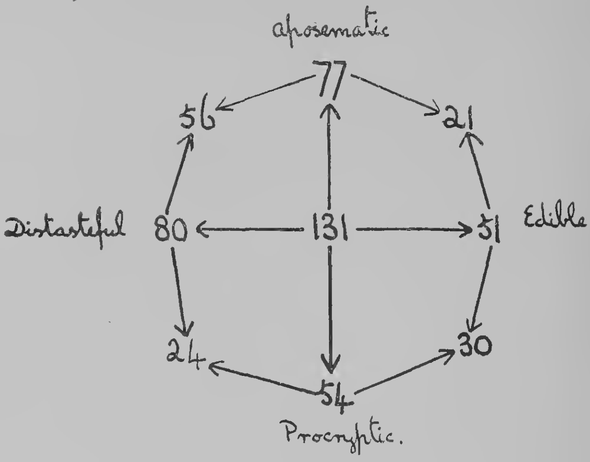
The curves for M_2 are not so remarkable, but, broadly speaking, the result is the same, and the letters at the margin indicating the curves are inverted on the two sides as they should be.

The detailed comparison between the two monkeys seems to indicate that M_2 was less severe in his classification as distasteful than was M_1.

The "ring-diagrams" give at a glance an analysis of the experiments with 244 species on M_1 and with 131 species on M_2. It is impossible for it to be a coincidence that of 143 aposematic species offered to M_1, 120 were classed by him as distasteful, while of 101 procryptic species 83 were found edible. Or, to take the result in another way, will coincidence explain the fact that of 51 species found by M_2 to be edible, 30 were procryptic, and of 80 found to be distasteful, 56 were aposematic?



It is claimed that these observations, numbering close on a thousand, upon insects taken at random as they were met with in the field, do yield practical, experimental support to the interpretation of the coloration of insects according to the Darwinian hypothesis of Natural Selection; that is, conspicuous species *are* distasteful and make the most of their conspicuousness to advertise the fact; while highly edible species endeavour to elude their enemies by hiding themselves. The fact must never be forgotten, however, that edibility and distastefulness are not *absolute*, but entirely *relative*, qualities, and a hungry monkey will eat, though unwillingly, an insect that he would pass over disdainfully when not very hungry.



M_2

Great care was therefore taken throughout the experiments, after the first few, to record the state of hunger of the animal, and to gauge the distastefulness of an insect by the amount of food taken before and after a specimen was refused. A perusal of the records of the experiments will show how frequently the words staple food (grasshoppers or weevils) occur.

This paper would have been very incomplete without the names of species, and I am greatly indebted to the experts who have identified them so far as possible, namely, Dr. G. J. Gahan, Dr. G. A. K. Marshall, Mr. K. G. Blair, Mr. G. J. Arrow, Mr. W. L. Distant, Dr. H. Eltringham, Dr. F. A. Dixey, F.R.S., Lord Rothschild, F.R.S., and Dr. B. P. Uvarov. Many of the species are new, others are in the National Collection, but are unnamed.

To my kind friend Professor E. B. Poulton this paper owes much for the trouble he has taken to get species identified, and for continual practical interest shown in the work from the time the experiments were commenced in 1917 in what at that time was German East Africa.

XIV. *Experiments on some Carnivorous Insects, especially the Driver Ant* Dorylus; *and with butterflies' eggs as prey.* By C. F. M. Swynnerton, F.L.S., F.E.S.

[Read May 5th, 1915.]

I have experimented at one time or another during the past few years in the food-preferences of various carnivorous insects. I include in the present paper only my experiments on driver-ants, and those in which insects' eggs were used as prey.

The driver-ants employed were *Dorylus* (*Anomma*) *nigricans*, Illig., var. *molestus*, Gerst., abundant on and about Mount Chirinda in S.E. Rhodesia. In the wet season (November to April) the collector comes across columns of them, particularly in dense forest, where the first intimation of their presence very frequently consists in sudden sharp bites all over his legs—or hers; for on two or three occasions some lady whom I have been escorting through Chirinda has disappeared suddenly into the undergrowth, and I have myself had to seek out some suitable spot further on in which to await her. I say "suitable" advisedly, for once, while striving to free myself of the intruders, I found them literally swarming all over me, and realised too late that in my haste I had sat down to search for them in another part of the same highly populous column.

The main column sometimes marches as many as twelve or fourteen abreast: I do not of course mean to imply that the ants are in definite lines. It is margined on each side, however, by a line, serried or broken, of grenadier-sized guards, each facing outwards with great uplifted mandibles or patrolling about on the flanks. Within the column there is usually a current in both directions, but very commonly mainly in one; and smaller "loop" columns help to prevent congestion and to serve, apparently, other special purposes. Over a foot, or, it may be, much more, of the ground on each side wander scattered stragglers that seize on any potential prey, from a minute beetle to a cow, that is so foolhardy as to approach them, and, aided, when struggling attracts attention, by the other ants near, drag it (if they can) into one of the columns. It is these stragglers that, in my particular experience, are the more frequent mark of the fly, the habits of which have been described by Mr. W. A. Lamborn (Proc. Ent. Soc., 1913, cxxiii–cxxviii).

Following the column, as it winds through the forest or over the grass-country, we may at last come to a place where the ants are scattered in hundreds of thousands everywhere, and are definitely searching—all over the ground, up the grass-stems, and up, sometimes for some distance, even the stems of trees. It is under these circumstances that I have on a few occasions, with insects abundant, been so fortunate as to witness the scene that Thomas Belt described so graphically, in connection with *Eciton predator*, in his fascinating "Naturalist in Nicaragua"—the seizure of the fleeing insects, the eventual overpowering of even grasshoppers, the clustering of the prey on the tops of the herbs and grasses, and its drop into the thick of the ants below when approached by those that climbed after it, and the escape by suspension of spiders and larvae. I have also on a few occasions watched birds attending *Dorylus*, as Belt says they attend *Eciton*, to rob stragglers of their prey, and for the sake of the flying and hopping insects flushed by the ants. Some of the birds on occasion eat the ants themselves. In my experiments on many species of insectivorous birds I found that some ate ants generally, including *Dorylus*, far more readily than others. Of these others some showed a strong repugnance to them, and it is doubtless in relation to this latter class of enemy that ant-mimicry finds its main use. Yet even the birds that prey on ants show caution in attacking *Dorylus* in column, merely (in my observations) dropping down to stragglers and hastily returning to their perch.

Ants of other species become very uneasy when drivers are near, and the carrying out of the contents of their nurseries by those that inhabit my verandah posts has often been a warning of the necessity for putting on pots upon pots of water to boil. Not that it is with anything but reluctance that one pours boiling water on these animals, so useful when they confine themselves to the Kaffirs' quarters, the kitchen, and the kitchen garden. But it is unpleasant to have to turn out at a moment's notice, at night, oneself; and, in my case, numerous live birds in cages in the verandah had to be protected from an enemy that would have made short work of them. *How* short, is suggested by the following incident. Some years ago (1902–3) three goats died under circumstances that suggested meat hunger on the part of my Kaffirs. Not to gratify them, I pretended to poison the carcases (using only salt, however), and placed them out in a lonely part of the Chirinda forest "to kill wild beasts." I might have spared even the salt, for they speedily became protected against the most venturesome native—or "wild beast"—by a dense, black, seething mass of "Idunga." They remained so for only a very few days. Then the ants resumed their more normal avocations, and left three skeletons behind them. It sometimes happens too that great stampeding is heard in the kraal or shed at night amongst whatever animals are enclosed in it, and, going out gun in hand, expecting perhaps to find that leopards have broken in or that lions are trying to make the animals break out, one finds the place full of—drivers.

I have on one or two occasions found quantities of chitinous *débris*—of millipedes, grasshoppers, beetles and other animals—mixed with earth in a heap outside what seems to be, at any rate, as near an approach to a permanent habitation as these ants employ; and once, in my garden, my foot suddenly went through and revealed a hole, perhaps eighteen inches deep, which was full of the driver-ants, though, it being in the dry season, it was long since I had seen them about. I could hardly have investigated properly without cyaniding them, and I did not wish to lose the protectors of my garden; but the discovery, and the fact that on several subsequent occasions I found them still there, suggested that they do possess headquarters and occupy them for prolonged periods.

It struck me early in 1911, when *Dorylus* was specially active in the neighbourhood of my house, that it would be interesting to ascertain whether any non-flying insects are protected from these marauders. I accordingly carried out the experiments I shall describe first. Two years later I carried out the experiments with butterflies' eggs.

I had found, in the numerous experiments on many insect-enemies in which I had used adult insects as prey, that not only do differences in acceptability exist, some species being obstinately refused while other species are eagerly eaten, but that the finest gradation exists between those insects (Z) that are only accepted when the enemy is hungry, though Y, X, W, etc., refused in turn as he fills up, to the few species (A) that are regularly eaten by him at all stages right up to repletion-point.

This fine grading in degrees of palatability was unexpected—though Mr. Marshall's experiments had shown that *some* grades might be looked for—and, starting with a bias in favour of the "palatability" of most *Nymphalinae* and *Pierinae*, I at first fought against it; but I could not long withstand the combined testimony of every animal I experimented on.

Fine gradation in palatability granted, with its corollary that few species are at all times acceptable to all their enemies, it was interesting to note its theoretical bearing. This seemed to be, that there are probably few species that do not sometimes require to be distinguished by an enemy from such other species (or, an important and highly explanatory consideration, from their own parent form) as are at the moment acceptable to him. The selective factors would be the unmistaken refusals and the mistaken attacks of enemies, adult and otherwise (for I find that even the former go on all their lives making numerous mistakes and that they also tend to test specially anything of unusual appearance).

Yet distinctiveness and diversity are nearly as marked in the eggs of Lepidoptera as they are in the fully developed insects that lay them.* These eggs are laid on exposed surfaces liable (as I have many hundreds of times seen) to the *exceedingly* close scrutiny of small warblers, white-eyes and other minutely-searching enemies; they are often in contrast to those surfaces and are commonly, even when not thus in contrast, distinctive; and this distinctiveness is apparently in part for visual effect, for it is absent from the hidden bases of the eggs, nor is it approached by that of most underground eggs known to me, the differences between which are merely such as might naturally result from the fact that their parents are different. I thought, therefore, that it would be interesting to ascertain whether nauseousness—and graded nauseousness at that—was present in leaf-laid eggs.

I was very unlucky in my attempts to secure a suitable animal on which to experiment. Two or three broods of small warblers that I tried to rear failed, and I could not secure a fully-grown bird of a suitable species. Finally I had to use driver-ants, unsuitable in so far as they possess no sight, yet suitable in their general apparent readiness to eat any animal substance, and in the fact that they must very commonly indeed meet with lepidopterous eggs when searching the herbs and lower shrubs on their foraging expeditions. I also tried other insects—cockroaches (suitable mainly in the fact that they are credited with the readiness to eat or, at any rate, try any food of an animal nature), a carnivorous ladybird (*Alesia bidentata*) and a cricket (*Arytropteris* sp.), which has often been a great nuisance to me, devouring insects of many kinds that I have left on the verandah table.

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* I lay stress on *distinctiveness*—recognisability when detected—rather than on *conspicuousness*, for I regard the latter as a purely auxiliary quality, though highly useful and likely always to be selected so far as it can be safely carried.

Obviously the animals were not perfect for my purpose; yet I felt that *rejections* by the drivers, the cockroaches and the cricket, also any preferences any of them might show, would at least, for the reasons I have indicated, be suggestive, though of course by no means conclusive. I therefore carried out on them the experiments which I shall describe.

A few remarks on the eggs used are comprised in the concluding section of this paper.

Note.—I have mentioned the fine grading of prey that occurred in my experiments on insectivorous birds, wild and tame, and the suiting of the capture or acceptance to the exact state of appetite of the moment. I show a diagram to illustrate these "layers" of appetite. It is also true (and this too has an explanation bearing on Dr. G. D. H. Carpenter's highly-interesting observations, read to-night *) that a rapidly digesting animal may go on eating a fairly low-grade insect (such as I have found many Lycaenids to be), or even *very* low-grade species, indefinitely, with occasional short intervals, if higher-grade prey is not available in sufficient quantity to carry it to a more advanced stage in the process of filling up. Thus a swallow of mine ate more than 80 *Neptis* and a small hornbill (*Lophoceros*) more than 50 *Danaida chrysippus*, in each case in quite a short space of time; a rest of a few minutes after each refusal, accompanied doubtless by subsidence, rendering the bird's digestive apparatus capable of dealing with three or four more. The swallow even ate more and at least as great a weight of *Neptis*, when thus verging continuously on the *Neptis*-refusing point, than it did of the better-liked *Pyrameis* at far nearer repletion-point in the same space of time. The possible bearing of this on some of the observations in which a bird has been seen preying continuously on *Danainae* is obvious; and a long-ago expressed view of Prof. Poulton's, based on his own experimental results, is also borne out—that it is only in the presence of pleasanter insects that unpleasant species will derive advantage from their special defence.* My experiments have shown, however, that it is a matter of relative indigestibility rather than of unpalatability, that a bird can digest species of prey when hungry that fail to stimulate the digestive secretions when it is fuller, and that a bird, enabled like my swallow and *Lophoceros* by a rapidly working digestion to prey fairly continuously on low-grade prey, probably never approaches repletion-point while doing so.

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* Proc. Ent. Soc., 1915, p. lxiv.

1. EXPERIMENTS ON *Dorylus* (*Anomma*) *nigricans*, var. *molestus*

April 26th, 1911.—A large stream of driver-ants was flowing in both directions between two tunnels, at the foot of a steep bank and under the verandah curb respectively.

I put down in the middle of the stream four *Mylabris amplectens*, Gerst., two *Amauris albimaculata*, killed by myself as I put them down and smelling strongly of ordinary gas, three *Epilachna polymorpha*, Gerst., and a *Zonocerus elegans*. All were at once overwhelmed by the drivers, and for some minutes remained so. Ten minutes later I found that the numbers clustering round the four *Mylabris* and the three *Epilachna* had thinned considerably, but the ants were still in masses on the *Zonocerus* and were busily engaged in cutting off the wings of the *Amauris*. A *Belenois* that I now put down was attacked at once, its wings cut off and left lying, and its head, thorax and abdomen carried into the bank "drive" before either *Amauris* was ready to follow it. A *Rhopalocampta libeon* was at once seized and carried along bodily, its wings being removed while it was in motion, and the two *Amauris*, their wings left where their owners had first been put down, followed it, also in sections. By this time the ants had entirely abandoned the four *Mylabris* and the three *Epilachna*. One of the former was on its back motionless, another was remaining quite still—head held down—in the centre of the stream of ants; many of them felt it with their antennae as they passed, but no attack was made on it, and the other two as well as the three Epilachnas were calmly marching off. They drew attacks in doing so from the ants they passed, and the two *Mylabris* in particular were occasionally overwhelmed for a moment and perhaps dragged back a little. But they were always abandoned again after a time and they made good their escape. I took them up and found that both *Mylabris* were still able to expel juice fairly freely, the *Coccinellidae* (with one exception, not, however, so freshly caught when given), apparently not. The *Zonocerus* continued to be the centre of attraction for large numbers of ants, but they were making very little headway in the process of its dismemberment.

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* Proc. Zool. Soc. Lond., 1887, p. 191.

I now inserted four larvae, one of *Papilio demodocus* at about the end of the brown-and-white stage, one of *Amauris albimaculata* (about $\frac{1}{3}$ grown) and two of *Acraea acara* ($\frac{1}{4}$ and $\frac{1}{3}$ grown respectively). All were at once surrounded, but the attack on the *Amauris* larva was not of a very formidable nature: the ants used their antennae rather than their jaws and evidently disliked it intensely, for they very speedily abandoned it entirely. In making off, which it did apparently quite undamaged, it drew a few attacks, but these proved to be no more formidable than the first, and the larva was each time quickly abandoned. The *A. acara* larvae were more seriously attacked, but the ants had the greatest difficulty in getting "in" at them, the much-branching spines beaded at all the extremities with the yellow protective juice everywhere barring their way. A number of these spines were in each case shorn by the ants (some close off to the skin) during the attack, but they finally abandoned both larvae, and, though I frequently replaced both these larvae and that of the *Amauris* in the centre of the ant-column during the remainder of the experiment, the subsequent attacks, when any were made at all, were less serious than the first, and the larvae were each time allowed to escape. Very different was it with that of the *Papilio*. It at once extended its red filaments on being attacked, but though the one or two ants in their immediate neighbourhood retreated for the fraction of a second they at once closed in again, and, overwhelming the larva, carried it speedily along (a distance of about three feet) into the verandah drive. A hive-bee at this moment came tumbling into the "drivers" from above. It was at once seized by the leg by one of the larger warriors, and remained tumbling over and over and drawing more enemies. I noticed that it extended its sting, but only to have it seized and tightly held by one of the drivers. It was quickly subdued, and when I last saw it was being carried in the direction of one of the drives. I now placed a large *Danaida chrysippus* in the column, first killing it. The ants at once persistently attacked it, and, having carried it just outside the column, commenced to dismember it. A smooth moth larva with a velvety appearance and conspicuous black and white bands (*Aletis*?), not uncommon in the forest, was seized, and after a very great deal of delay carried along to the bank drive, though the ants again refused the *Amauris* and *Acraea* larvae. It had been three days in captivity without my having been able to find its food-plant and was undoubtedly weakened—probably in its protective qualities too. A *Papilio echerioides* ♂ was broken up, its wings left lying, and its more material parts carried in sections to a drive. A small Sciarid fly with black wings and a red thorax (*Apelmocreagis thoracica*, Macq.) had been settled on the ground right amongst the ants, neither taking any notice of them nor drawing an attack. I captured and disabled it and placed it back amongst them, but though numbers, I might say hundreds, inspected it, often passing their antennae over it, all moved on and no attack whatsoever was made. But an Arctiid moth, *Rhodogastria bubo*, was at once attacked and its wings stripped off where it lay. It had unfortunately exhausted its foamy thoracic exudation previously to being placed amongst the ants: this might have made a difference. A *Mycalesis campina* was at once carried along, as were also a second *Danaida chrysippus* and a *Byblia ilithyia*, their wings being stripped off *en route*. It was now an hour and a quarter since the experiment commenced: the *Mylabris* left in the column was still in the same place uneaten but motionless, and no longer noticed by the ants. On my taking him out he immediately commenced to move about, but dragged three legs after him: the two previous *Mylabris* had escaped to all appearance quite without damage excepting for a slight wound on an abdomen. The fourth *Mylabris* had, as I ascertained, quite exhausted its juice. It had latterly been receiving a good deal of attention from the ants, which were at this moment busily cutting off one of the elytra and were carrying its owner along. They soon abandoned it again, but when I removed it later I found it to be dead. The large ♀ *Zonocerus* was lying where originally placed, but had been reduced a good deal and was still a great centre of attraction. The small fly was still lying neglected in the midst of the ants. A *Mylothris rueppelli* was now broken up and carried off, as were, without breaking, a housefly and a common cockroach. Three of the ants themselves which I killed and put back in the column were felt by large numbers of their comrades, but always passed by until suddenly one smallish ant, coming across one of them, seemed to think it her duty to lift and carry it along. I removed one of the other two and placed it in another ant-army of the same species which was busily crossing a garden path at a considerable distance away, with, as so often, a drive at each side. It, too, was neglected for the three or four minutes during which I watched.

The first ants had shown no special ferocity towards myself, but this second party at once attacked me, and I had to keep a sharp eye on my feet. Judging that they might also be in the mood to take more highly unpleasant insects than their comrades had accepted, I brought over an *Epilachna*, a *Mylabris* (adding a second from the two that had escaped), the small fly, the *Amauris* larva and one of the *Acraea* larvae; all these were still being neglected by my first band of ants. Placed just beside the column all were at once attacked furiously. The *Acraea* larva (it was the larger one) was gradually shorn of spines and finally carried into a drive, as were *both Mylabris* and the Coccinellid. The *Amauris* larva was attacked just as furiously and was apparently freely bitten, for blots of greenish black juice sprinkled the ground on either side of it. These seemed to fall just *away* from it: were they *emitted, e. g.* by the filaments? But the original attackers gradually desisted and left it, though it was still for some time attacked by groups of ants that apparently came across it for the first time. Finally it was left alone entirely, and, looking back at it at the end of the *Acraea* larva incident I was surprised to find it half-covered with little heaps of tiny fallen leaflets from an overhanging *Acacia baileyana*. Watching, I saw several leaflets and in one case a portion of a midrib with a few leaflets attached brought up and placed on it by the ants. The fly had appeared to be attacked for a few moments with the same vigour as were its fellow victims, but evidently the onslaught was not with pointed weapons, for apart from the loss of a wing it seemed to have sustained little or no damage when the ants abandoned it. It lay in the midst of them and, whenever I moved it, was at once set on to by the ants, but they quite evidently had no use for it and each time speedily desisted. The fact that the two *Mylabris* had already undergone an ordeal at the hands of Column No. 1 and that one of them was certainly destitute of "juice" might, I thought, account sufficiently for the comparative readiness with which they and, for that matter, the *Epilachna*, had been taken. I thereupon captured (within a few yards of the column) two more, also just afterwards a fresh *Epilachna*, and at once, as I did so, put them in. I happened to drop one *Mylabris* close to a vertical shaft that was guarded at its mouth by a large number of ants. It was at once pulled in. The second, placed further along, was attacked with great fury and carried along for some distance, then partially abandoned, then attacked again and so on. Finally, after a considerable time, it was left out to one side of the column and partly covered over with leaflets like the *Amauris* larva. The latter had now emerged from its covering and was crawling towards the column. It was attacked three or four times, particularly when it arrived at the column, but never very seriously—the ants mostly desisted directly they came into contact with it—and it passed out on the other side. On picking it up I found that it seemed not greatly the worse for its experience. The front pair of filaments were hanging down limply and all the others were partially collapsed, but on my setting it on a leaf of its local Asclepiad food-plant (*Cynanchum chirindense*, S. Moore) it at once commenced to eat. The fly, put down again, was treated with the same respect as previously. But a large beetle, *Psammodes* sp., now introduced was attacked furiously and was quickly concealed under a mass of ants. Nevertheless, it gradually crawled away, the ants lessening as it went, and on getting off the open path and passing through some vegetation it succeeded in brushing off most of those that remained. It was greatly incommoded by them, and kept stopping to brush them away with its forelegs from its palpi and antennae. When I finally recovered it, several yards from the ant-column, only three ants were left clinging to it, and it seemed to have been effectively saved by its armour from all injury. The *Epilachna*, I should have mentioned, was attacked vigorously for a time, and afterwards for a longer period in a desultory fashion. It at first remained adpressed closely to the ground, and the ants plied their mandibles in vain over the glossy surface of the elytra; then one or two pushed under and turned it over, and it was carried along a few inches. This sort of thing went on for some time—I could not see that it made use of any juice it may have possessed. In any case, the ants made very little impression on it, and did not shift it very far from its original station.

At this point, having just captured a passing *Acraea neobule* ♂ and an *A. natalica*, dull ♀, I went with them to Column No. 1, and found the last remains of the *Zonocerus* disappearing into the drive. I removed a forewing of *A. neobule* and placed the butterfly amongst the ants. Disabled even to that extent it seemed to have no difficulty in its flutterings in shaking off such as clutched it, and a butterfly of its size, able to fly, would, I have little doubt, experience very little trouble in getting away from a crowd of drivers amongst which it had inadvertently landed. I killed it and replaced it. There was quite the normal amount of juice, but the ants made as short work of it as they had done of *Amauris* and *Danaida*, separating the wings from the body and carrying the latter into their tunnel. They then refused, in the same manner as before, to eat the *Amauris* larva and the fly, attacked a *Mylabris* and desisted, then attacked and carried in the *Acraea natalica*. It too possessed a normal amount of juice, and small drops of this exuded at the nervures when I cut the wings off.

Returning to Column 2 I found the *Mylabris* and the *Epilachna* in the same place. I put down two coffee-bugs (*Antestia variegata*), a small weevil (*Systates* sp.) common in coffee, and a beetle, *Himatismus fasciculosus*, Pér. The weevil was carried to a drive at once. The bugs caused delay and were carried hither and thither a little, but finally brought to the main track and taken to a drive. When I last noticed *Himatismus* it too was being dragged along. I then put in eight *Antestia variegata* and eight weevils. All were seized—it was impossible to see whether one was preferred to the other—and carried along.

I now went back to Column 1. It had moved on to some extent, and a number of its members were busy exploring, and apparently enlarging, a vertical hole in the ground, out of which I saw them bring up three white bee larvae. A number of large guards were stationed in a mass over the hole, and a thin stream of ants passed between these and the bank. On the other side the stream was thinner still. I put an *Antestia* on each side. That away from the bank was once or twice attacked half-heartedly and was inspected by a number of passing ants, but on the whole left alone. Very different was the treatment accorded one of the bee grubs. I placed it beside the bug, and it was at once seized and carried off, several ants joining in. The bug continued to be ignored. The other bug, however, had been seized and carried to the mass of guards. One of these seized it, and straddling over it carried it back the way it had come, and finally disappeared with it into the hole in the bank.

Returning to Column 2 I found the *Epilachna* and *Mylabris* still in the same place, and I was just in time to see the last bug and the last weevil disappear into the drive. I should have said that before I left, the *Epilachna* had more than once escaped, practically unmolested, from the ants, but that I had each time put it back. I now put in five fresh *Mylabris amplectens* and a smallish *M. oculata*. Considerable excitement ensued amongst the ants, and the beetles were being dragged hither and thither, when a large reinforcement, including a considerable proportion of the largest workers, emerged from one of the drives, and, seizing the beetles, including the *Epilachna*, carried all along, often with a great deal of delay, into the opposite drive. One beetle only withstood the attack, and that was the original *Mylabris amplectens*, a very large specimen. It was attacked like the others, but relinquished, attacked again and again, left, and so on, until at the end it was not much nearer the opposite drive than it had been before. The *Amauris* larva, the remaining *Acraea* larva and the fly, which I put in once more, were treated much as on previous occasions, and finally left high and dry. But the rush was already lessening somewhat by the time they were inserted, and a little later, when the column had subsided to its normal dimensions or rather less, it took very little notice of three more coffee-bugs and soon abandoned them completely, though a small Elaterid was at once seized and hurried along to the opposite drive.

Meantime, the other party had established better "through" communications once more, and though comparatively few in numbers seized and carried off into the bank eight coffee-bugs, three weevils and a *Harpactor erythrocnemis* (also taken in coffee), though still ignoring to the same extent as previously the *Amauris* larva and the fly. They attacked a small *Mylabris amplectens*, but eventually abandoned it.

Later, having captured a fine ♂ *A. areca*, I returned the *Amauris* larva and the fly to Column 2, where a large number of ants were passing. Both were treated as before. Two Epilachnas were attacked, but eventually abandoned and gradually allowed to escape; the original *Mylabris amplectens* was still present, drawing an occasional slight attack, but was mostly left alone; a dead *Dorylus* was ignored for a while, but then picked up by one ant and carried along; the *Acraea* larva was attacked, but allowed to escape. Afterwards, as it was moving along parallel with the column, I was amused to watch it meet a large number of ants. As each stopped and felt it with its antennae the larva would stop dead. When the ant moved on, as it invariably did at once, the larva would move on too. There was no further attempt at an attack. A small piece of banana pulp that I put down was attacked, several ants making off to the drive with portions of it, and an ordinary cattle tick (*Rhipicephalus* sp.) was seized and carried to a drive, but not until it had inconvenienced its carriers very greatly (three in all carried it, but only one at a time) by getting under them and clinging to their legs. A coffee-bug was seized and carried along. Then *A. areca*, with wings shorn $\frac{1}{3}$ of the way up and exuding juice, was placed amongst them. Even in this condition it was too active for them, so I killed and returned it, when it speedily became a seething mass of ants. I put down just afterwards an *Amauris albimaculata* with its wings attached and a coffee-bug. The latter appeared to be attacked somewhat less readily than the two butterflies, but once definitely seized was carried along fairly fast; the *Amauris* was dragged wings and all, and, considering that it made a broad and heavy load, proceeded with considerable speed. It was at the hole and in process of being diswinged there before the *A. areca* had travelled more than three or four inches. I had noticed at first three or four ants withdraw on coming into contact with the liquid exuding from the nervures of the Acraea's wing-stumps, but the butterfly's juices, though normal in quantity, were either insufficient or not unpleasant enough to keep its enemies off. At this moment a fresh rush occurred, and I at once returned the two Epilachnas, the *Mylabris*, the two larvae and the fly to the main track. The two ladybirds were at once carried off into the drive, as was, after more in the way of hesitation and temporary abandonments, the *Acraea* larva; the *Mylabris* was carried to the mouth of the drive, but as I saw him crawling about that neighbourhood half an hour later was probably abandoned there or just inside. Considerable disinclination was still shown to attack the *Amauris* larva, and it was only by moving it frequently in their midst that I irritated them (for that I presume was it) sufficiently to make them really attack it. When they did, they attacked with the utmost ferocity, and having killed or practically killed the larva, carried it along to the drive. I rescued it at the last moment, wishing to use it further. It had this time emitted no dark juice.

Similar, if not greater, disinclination was shown to attack the fly, but finally this, too, was seized and carried along by one big warrior. It was still a considerable time before the *A. areca* reached its destination, and was there broken up and carried in, but there was never any abandonment of it; it was always covered with ants.

At about this stage I again put in the *Amauris* larva, and, on the magnifying glass to which it was attached a freshly pupated individual of *Amauris albimaculata*, somewhat crushed accidentally. The ants refused the larva, and though numbers swarmed upon the glass to the pupa all retreated on coming into contact with either it or its fluid, and no attempt was made to carry if off. I tasted the fluid; it was to me reminiscent simply of raw leaves of no very definite kind.

Later, having again ascertained that the ants would not touch the *Amauris* larva, though an imago of the same species was at once carried along, I interrupted the column by placing in its midst a rather spread-out mass of not less than 200 coffee-bugs thoroughly mixed up with about a third of that number of the weevil *Systates* and a few *Himatismus*. Half an hour later the pile had been reduced by about half, the ants taking the insects as they came from the outside and not choosing between weevils and bugs. An hour or more later, by lantern light, I found the column reduced to almost nil and the bugs to between twenty and thirty. They were somewhat scattered and more or less piled up between with loose earth and *Acacia* leaflets, a very scanty layer, however. No weevils or *Himatismus* were left. I inserted an *A. albimaculata* and a *Leuceronia thalassina* ♂, but the few smallish ants that were still using the track took no notice of them, beyond stopping to inspect *en passant*. Shortly afterwards I noticed that a fresh track had been made alongside the old one, and more ants were passing along it. The old one with the butterflies still in it was now quite deserted. I placed them together in the centre of the new track, about equidistant from each drive, and saw both seized. On returning a few minutes later I found them being dragged in opposite directions. The *Leuceronia* was going at unmistakably the better pace and had already practically reached its goal; the *Amauris* with about the same number of ants was barely half-way. Now, ten minutes later, as I am about to go to bed, the *Amauris* has only proceeded about two inches further. I had removed the *Leuceronia* on my last visit, wishing to use it further; it was then within an inch of its hole. The ants had made no attempt to strip the wings off either.

April 27th, 1911.—I looked once more, for the last time, ten minutes after the above was written. The *Amauris* had only proceeded another two inches in spite of the fact that since I removed the *Leuceronia* the number of ants engaged on it had more than doubled. They seemed to be spending as much of their time in feeling over the surface of the butterfly as in carrying it. The bugs, though a number of ants was passing round them, were being completely neglected.

This morning the wings of the *Amauris* were lying just outside the drive.

Later: Found this afternoon where the above drive emerged, ten yards away, four or five of the bugs lying abandoned though continually passed by the ants. At the spot experimented at yesterday the 20–30 bugs are still lying untouched, though a large stream of ants is passing them. I put in a *Rhodogastria bubo*, just captured and commencing to exude froth. It was at once seized by the legs and commenced to froth most lavishly; but though the froth certainly discommoded such ants as came into contact with it, it was confined to the thoracic region, and the rest of the moth was quickly covered with its enemies. Also, in its struggles, the mass of froth was quickly knocked off and no more was forthcoming. I rescued it at this point and had to pick a large number of drivers from its legs.

On the coffee-girls bringing in their daily kill of bugs (*Antestia variegata*) again this evening, I placed a few in the ant-column close to where the remains of yesterday's still remained untouched; also an *Epilachna hirta*, just captured. The latter only was attacked, but never seriously, and was twice allowed to escape. I noted that such ants as came into contact with the protective fluid drew back slightly, but I also noted once more their failure to grasp or pierce its glossy elytra with their jaws. It would be interesting to see whether the fluid without the glossy hardness of the beetle's exterior would be a sufficient protection.

On, I think, the following day—April 28th—I found large numbers of *Antestia* thrown out of the drive, at the mouth of which four or five were lying on the 27th. None of the beetles taken with them had been thrown out.

May 12th, 1911.—A column of *Dorylus* was busily exploring the recesses of an old post to-day, and dragging out thence the larvae of wood-boring Hymenoptera. I placed in their midst eighteen full-fed cattle-ticks (*Rhipicephalus*, sp.). They were at once smothered in masses of the ants, but fifteen minutes later, though still lying in the midst of the column, they had been abandoned completely. They were apparently undamaged. One of my ground-hornbills (*Bucorax caffer*) stalking along shortly afterwards ate them all, but took no notice of the drivers.

Yesterday when I was cutting up a sheep, and throwing an occasional waste bit to the hornbills (*Bucorax caffer*), I threw one such piece into the midst of a column of "drivers." It was at once covered with the ants, but a hornbill at once strode up, picked it out and, after shaking off only a few of the ants, swallowed it with all the rest that were clinging to it.

Remarks.—The ants were unconfined, carrying on their ordinary daily avocation. The experiments cannot therefore be criticised as having been carried out on animals under "highly unnatural" conditions. Yet the ants showed strong "preferences," readily taking some animals when they would not take others at all, and when failing in their attacks on yet others. It is true that some of the winged insects offered were, because winged, not such as the ants would normally have an opportunity of seizing except when hunting at night—but they do hunt at night greatly. Most of these were nevertheless taken by them, and, even if we should exclude these as not forming a part of the ants' normal food, we should find that a number of species were offered that the ants must meet with continually, and that very strong "preferences" were shown even as between these.

The butterflies tested, the moth *Rhodogastria bubo*, the larva of *Papilio demodocus*, a hive-bee, the larvae of a bee and of a wood-boring Hymenopteron, a cockroach, the beetles *Himatismus*, *Systates*, and an Elaterid, and a *Zonocerus elegans* were probably all less protected from *Dorylus* than even the weakened larva of *Aletis monteiroae*, and certainly than the larvae of *Acraea acara*, than adult *Mylabris amplectens*, *Epilachna polymorpha* and *E. hirta*, and *Antestia variegata*, and all these, apparently, than the fly, the larva and pupa of *Amauris albimaculata* and the beetle *Psammodes* (protected by hardness). But the ejection from the tunnel of a large number of *Epilachna* a day or two after they had been taken in may indicate that these were found to be as bad as any of the objectionable species. Certainly the ants found the fly and the Danaine larva and pupa much more *obviously* unpleasant than the Epilachnas, *Mylabris*, *Antestia*, and *Acraea* larvae, and it is clear from an experiment to be described below that the latter when well-grown are acceptable enough to them if they give the ants time, and the latter are persistent enough, to raze the juice-dealing hairs.

The butterflies used were *Danaida chrysippus*, L., *Amauris albimaculata*, Butl., *Mycalesis campina*, Auriv., *Acraea neobule*, Dbl. and Hew., *A. egina*, Cram. var. *areca*, Mab., *Acraea natalica*, Boisd., *Byblia ilithyia*, Drury, *Mylothris rueppelli*, Koch, a *Belenois*, *Leuceronia thalassina*, Boisd., *Papilio echerioides*, Trim., and *Rhopalocampta libeon*, Druce. It seemed that the Acraeas gave a little more trouble, with their juice, than did *Amauris* with its pungent smell, yet this did not save them even for a moment. That *Amauris* in time may have been better protected than *Leuceronia* (and probably others) seemed to be suggested by the slowness with which the ants would progress with it, "spending as much of their time in feeling over the surface of the butterfly as in carrying it." The froth-masses of *Rhodogastria bubo* and the bay-leaf-scented filaments of the larva of *P. demodocus* were only momentarily and locally deterrent, and the sting of the hive-bee not at all. The *Zonocerus* with its (to us) nauseous smell and its ill-effects on vertebrates eating it, was naturally more slowly dismembered than the smaller species used, but that was all. Quite unprotected also, apparently, were beetles *Himatismus*, *Systates*, and the Elaterid, the cockroach, the hymenopterous larvae, and adult *Musca domestica*. A hungry cattle-tick was taken, though full ones, on another occasion, were all refused; but a very interesting incident in the experiments that follow should be seen in this connection.

The acceptance of vegetable-matter (banana) was interesting, as was the fact that even partly-disabled Acraeas—not the most active of butterflies in any case—were able to escape for a time from the drivers. With power of flight they should never be taken except when asleep. This consideration, with the *special* repugnance shown to eggs and very young larvae in the experiments still to be described, suggests a very beautiful instance of the probably universally obtaining principle of compensation and complementation and of the fact (implied therein) that an animal's defences may vary greatly at different stages of its existence, one defence being donned in proportion as another is doffed, and *vice versâ*. Thus in both *Acraea* and, say, *Papilio dardanus*, numbers and intrinsic nauseousness, at their height in the egg-stage (assuming the experiments to be reliable), and then most necessary, are gradually exchanged, in the first case for an ever-growing supply of protective fluid, in the second for an ever-increasing procryptic element in the coloration, this culminating in the extraordinarily complete resemblance to a growing Rutaceous leaf displayed by the pupa. Each emerges. The *Acraea*'s fluid-supply has been much decreased, yet is efficient enough in relation to present enemies, and its flight is sufficient to commonly save it from the driver. The *Papilio* has flight, and, instead of a protective fluid, has polymorphic mimicry in the female (compensated in the male by better flight and slightly greater nauseousness), and a strong procryptic element in the "matching" of the dulled underside by both sexes in resting. I have already mentioned the native view of nestlings, and I am publishing elsewhere ("Ibis") the results of some actual experiments with birds' eggs: a stronger procryptic element, represented most usually in the *nests*, is present here than in the case of butterflies' eggs; also parental protection; so that nauseousness is to a varying extent less necessary, though it is often, I believe, in some degree present to complement or replace these other defences. Those plants in which the seedlings are less liked by herbivora than is the adult foliage (protected by height, etc.) afford a somewhat closer parallel. though they trust more than even butterflies to their reproductiveness. It would be very interesting, in view of recent observations that have discredited the view that it is myrmecophilous, to ascertain whether the bull's-horn thorn acacia of America is not one of them.

Further interesting points in the experiments were: (1) the effect on survival of, *apparently*, variability in juice production or conservation in individuals of *Mylabris*, one such individual, a large one but amongst the first to be inserted, remaining protected to the end, while others were taken and one was definitely exhausted of juice and killed; (2) the shearing of the spines of *Acraea acara* larvae. This was improved on in a subsequent experiment in which the juice was absorbed by the application of earth-crumbs. I have on a few occasions seen *Acraea* larvae feeding with similar earth-crumbs attached to their bristles, and there can be no doubt that the ants' successes against Acraeine larvae in these experiments were mainly due to my replacing the escaped larvae amongst them time after time; (3) the behaviour of an *Acraea* larva meeting successive ants, then not prepared to attack it; (4) the ants' *general* variability as to the food they would accept, rather surprising and reminding one somewhat of the different stages of hunger in a bird; (5) the release of a *Mylabris* from a drive into which it had been carried, and the ejection, long after taking, of a number of *Antestia*; (6) the apparent failure to grasp glossy *Epilachna*—yet on one occasion some were carried off; (7) the earthing or leafing up of highly unacceptable objects (for the treatment of Acraeine eggs in the same way see below). One felt that it *ought* to have been for visual effect, yet of course it could not have been. The leaflets and earth-crumbs may have been specially scented by the ants, but why should it not have been sufficient to do this to the animal itself, as was apparently done in the tick-incident yet to be described? Experiments of this kind lead one to wonder, throughout, at the completeness with which other faculties are capable of taking the place of vision.

At any rate several animals—the fly, the larvae of *Acraea* and *Amauris*, the pupa of the latter (which was highly interesting), adult *Mylabris*, *Epilachna*, *Psammodes* (through hardness) and *Antestia*, all of them (unless *Antestia?*) with habits that place them at the mercy of *Dorylus*—probably the greatest scourge of relatively low-dwelling insect-life we possess—proved to be highly protected against it; and *Dorylus is* such a scourge that its attacks and its failures may reasonably be regarded as having aided appreciably in the selection (to their present high pitch) of these insects' protective qualities.

Of the potential prey itself, it is sufficient to say that all the animals just named except *Antestia* are highly sluggish and indifferent to attack. *Antestia*, our greatest coffee-pest, less so. It possesses a strong "bug" smell, and is conspicuously coloured, but it drops and flies and dodges round twigs somewhat readily. Even so, it is not very hard to catch, my coffee-girls bringing in great numbers daily when destroying them by hand-picking. It probably has special enemies: one of my tame but unconfined ground-hornbills (*Bucorax caffer*) once ate 193 in quick succession, and "capped" them with an *Amauris albimaculata*. We have also seen in the present experiments how *Dorylus* accepted them relatively readily, once in large numbers, though it subsequently did eject them.

In general, given that *Dorylus* readily accepts insects as low-grade as the *Acraeinae* and *Danainae*, the ants' acceptances and refusals come in line with those of my birds; for the latter too placed these butterflies above,

e. g., *Epilachna* and the larvae of *Acraeinae*, of *Danainae* and of certain other butterflies. This, on such general considerations as I have alluded to above, is only what one might expect. What, on those same considerations, one would *not* expect is that *Zonocerus* and *Rhodogastria*, both far more sluggish and apparently helpless than any of our *Danainae*, etc., should have been as readily accepted by the drivers, and placed slightly *above* the *Danainae* and *Acraea areca* by my birds.

2. Experiments with Insects' Eggs

April 28th, 1913.—A horde of the driver-ants had retired in the evening into their "drive," but at every opening there were warriors standing sentry with upraised open jaws, and a few ants were walking about aimlessly or resting. I put down four eggs of *Acraea caldarena* attached, as laid, to a small scrap of *Wormskioldia* leaf. They were closely inspected by several ants, but no attempt was made to take them. I then added an egg of *Papilio dardanus* ♀ f. *hippocoon*. This attracted less attention: one warrior took it listlessly in his immense mandibles and, as I found afterwards, must have used just enough force to separate it from its leaf (*Teclea*), then left it without having damaged it. An egg of *Pseudacraea lucretia* var. *expansa* was also ignored.

April 29th.—This morning I visited an active column of *Dorylus*. The ants were keeping to their narrow-column formation and travelling rapidly, mostly in the same direction. I put down three eggs of *Acraea aglaonice*. These were examined by many ants but not attacked, and soon became shifted to the side of the column, amongst the guards. I then put down two eggs of *Pyrameis cardui*. The ants took absolutely no notice of these, merely scurrying over them, and they too had soon found their way to the side. A *P. hippocoon*'s egg followed. It remained unheeded too, but it formed a good-sized obstacle, and soon a passing ant picked it up and deposited it outside, then returned to the column without it. Two more eggs of *P. cardui* followed the example of the first two. All eggs in this experiment had been separated from their leaf before being offered. Were the eggs all definitely unacceptable to the ants? Were they too small to be worthy of notice? Were the ants too busy otherwise at the moment to take notice of food? or (an unlikely supposition) were the eggs (one of which had been treated as an obstructing pebble might have been) regarded as of the mineral or vegetable kingdoms? I returned to the house and cut up a small piece of meat into scraps as small as a *P. dardanus* egg, and twenty minutes later returned to the ants.

The meat scraps were becoming dry. I put one in the track, and it was at first passed over, then seized and thrown outside as the *dardanus* egg had been. A second piece was treated in the same way. But a moist, freshly-extracted egg of a smallish, dull-coloured grasshopper was at once picked up and carried along, as was a freshly-cut-off piece of meat four times the size of a *dardanus* egg. But a similar piece of half the size was thrown outside! However, on my returning it, it was at first for a time passed by, then an ant took it and kept with it in the column. An egg of another species of grasshopper was set on to by three or four ants, and it was some time before one of them finally carried it along in the column. I then crushed and put in together three eggs of *A. acara*. They were picked up and carried along. To test what the ants were prepared to rise to in the matter of unpleasantness I next placed an adult *Acraea terpsichore*, L. (the only *Acraea* I had with me), first killing it, three or four inches from the column. It was quickly found, a mass of ants covered it up, the wings were gradually taken off at the base and the body brought into the column and carried along.

May 1st.—Again tried *Dorylus*—yesterday's column, as active as previously. I put in in turn slightly developed, unbroken eggs of *Papilio dardanus*, ♀ f. *hippocoon*, *Papilio demodocus* and *Pyrameis cardui* (four or five of this). They were in each case either completely ignored or merely picked up and dropped outside. Eggs of *A. acara* and *A. aglaonice*, put down two or three together, were completely and continuously neglected. I watched for quite half an hour, occasionally moving the eggs back into the run, but nothing other than what I have described occurred. But an egg of *Charaxes ethalion* (new-laid, plain green and not yet ringed) almost immediately found a carrier, and was taken along to the next outpost in the direction in which the main body was moving.

Two eggs of *hippocoon* extracted from the body of their parent and placed still wet in the run attracted much more attention. Many ants examined them and some went so far as to enclose one or other with their mandibles, but each time at once desisted and went on.

After waiting for some time longer I collected all the eggs, then broke slightly two or three eggs of *A. aglaonice* and put them in together. They were largely ignored, but occasionally examined, and they found no carrier. A similarly-prepared *P. demodocus* egg was treated in the same way and of the two extracted *hippocoon* eggs one eventually found a carrier, being taken by a small worker with immense difficulty *against* the main current right back to the station the latter was leaving, nearly three yards off. An interesting incident occurred at the outset—all the more interesting because the ant was sightless: she had the greatest difficulty in making any headway, and eventually dropped out to the side and, waiting till three or four large ants with good-sized loads came along in the desired direction, fell in behind them. She was unable to keep up with them for very long, but eventually reached her goal. The other extracted *hippocoon* egg was finally picked up and thrown outside the column. Eggs of *P. cardui* (three or four partly broken and forming one mass) were examined, picked up and carried along, but two unbroken eggs of *C. ethalion* were ignored (as were, still, the broken eggs of Acraeas, etc., the treatment of which I have just described). On being broken, however, the two *Charaxes* eggs, one new-laid, the other already with a dark apical ring, each quickly found a carrier. A large adult male *Acraea doubledayi*, killed by myself and placed outside the column, was overwhelmed, diswinged, and carried away.

I added more *Pyrameis* eggs, but the rush of ants was now very great, and it was possibly for this reason that the eggs were continuously overrun, apparently unnoticed. So I turned my attention to one of the side columns. Here eggs of *A. aglaonice*, broken together, received a great deal of attention but found no carrier; a new-laid egg of *C. ethalion* was soon picked up and carried by a side connection into the main column; eggs of *A. acara* were treated exactly as those of its congener had been, but three or four *P. cardui* eggs were picked up together and carried to the station ahead; an egg of *P. demodocus* was treated as the *Acraea* eggs had been, but a semiincubated *ethalion* egg found a carrier. Thinking I might have crushed the *demodocus* egg so much as to render it unattractive by loss of contents I added another of the same brood very slightly crushed (in each case by pressure of a pin-point). This too was much examined but not taken, and one ant picked it up and dropped it outside the run. On my returning it, the egg was treated as before, but eventually an ant carried it for about eight inches, then once more deposited it outside. The *Acraea* eggs also remained untaken all this time, though frequently examined, but, on my putting down two *Pyrameis* eggs with a third of the same species crushed against them, they (the *Pyrameis* eggs) were picked up by a small ant and carried forward to the station. A further batch of two or three *Pyrameis* eggs was ignored, and the next half-incubated *ethalion* egg was examined by two or three ants and neglected. Whether these eggs would have continued to be neglected I am unable to say, as I had now to discontinue the experiment.

This description gives no real idea of the tediousness of the experiment, which lasted about two hours. In almost every case the egg was passed over by far more ants than noticed it, and the difference between the eggs of the Papilios and the Acraeas on the one hand and those of the two Nymphalines on the other, was that whereas the former were very frequently examined they remained untaken to the end, while the *Charaxes* and *Pyrameis* eggs were picked up and carried by the first or nearly the first ant that stopped to notice them.

I should say the *C. ethalion* eggs found carriers more readily than *Pyrameis* eggs. I was unable to find, for the broken-egg experiment, the half-incubated *hippocoon* egg I had used previously.

In view of *Acraea* eggs having been accepted the day before yesterday, their rejection in this experiment requires confirmation.

[On leaving the ants I found a medium-sized cattle-tick (*Rhipicephalus* sp.), and going back put it in the run. Some ants ran over it without stopping; one or two halted and examined; then one took it by the side and retiring to the side of the column held it there, merely preventing it from moving away, herself in meantime lying over on her side. As the stream of ants went ceaselessly past a number of its members—one at a time, two at a time, or several at a time—would fall out, examine the tick well and then pass on. The examination frequently ended up with the adpression of the end of the ant's abdomen to the surface of the tick. I had previously seen them do this to some of the eggs when examining them, and once one ant did it to another. I watched the performance for quite fifteen minutes, and it was still going on when I left. Was it a demonstration to the younger generation of the distinctive characteristics of Mr. Tick? Or were they submitting their opinion of him? Or was he merely being detained until some official of the tick department should come along and take charge? !]

In the latish afternoon I returned to the spot and put down in turn in one of the smaller side columns the eggs (well-punctured) of the following butterflies:—*A. caldarena* (two lots of three or four each); *P. dardanus hippocoon* (two); *P. demodocus* (one); *P. cardui* (four, forming a single mass); *Eurytela hiarbas* (one); *Hypolimnas misippus* (two); and two *C. ethalion* (unusually small and yellow, not green, and with a very narrow ring). Throughout the experiment, which lasted a considerable time, I saw no notice at all taken of the hairy egg of *E. hiarbas*—it merely became automatically pushed out to one side each time I returned it to the column. I forget whether I saw the *Pyrameis* eggs definitely inspected—at any rate, they found no carriers and met with the same treatment as that of the *Eurytela.* At least once an *H. misippus* egg was inspected, but neither was taken. The *hippocoon* and *P. demodocus* eggs were always carried outside, never along, and at first the same was done to the two *C. ethalion* eggs. Seeing this, I added a green *ethalion* egg of the brood from which I had used in the morning. This quickly found a carrier. I added yet another and an egg of *P. lucretia* var. *expansa.* Each was shortly thrown outside, but only a few minutes later the *Pseudacraea* egg was again picked up, and this time carried right on to the next station.

The *A. caldarena* eggs were sometimes inspected and always refused, and so were some *A. acara* eggs that I now added, together with two more eggs of *Pyrameis* and another of *P. lucretia.* The *C. ethalion* eggs were being frequently inspected and occasionally picked up, but none were carried away, and once an ant, having inspected and refused one of them, passed on to the *P. lucretia* egg close by (it had been put outside the column by an ant which had come into contact with it), and, after examining it, picked it up and carried it along with the column to the station ahead. I now put down close beside each other ten punctured eggs of *A. acara*, already turning purplish brown from incubation. My putting down so many in quick succession disturbed that portion of the column, and there was a very slight movement out in my direction, during which a number of ants came into contact with *Acraea* eggs and inspected them, in every case briefly and with rejection following. Two or three of them now set to work and placed small pieces of earth on top of the eggs, a good-sized piece of dry grass-blade crowning all. This has only been done in my previous experience to the most highly unacceptable of prey, and it constituted, I believe, the best possible evidence of the ants' definite repugnance to the eggs. After they had been thus branded, the eggs, though still visible to myself, were no longer, so far as I saw, the subject of examination. About this time the green *C. ethalion* egg found a carrier. Rather earlier in the experiment the *P. demodocus* egg was taken up, though lying outside the column, by an exceptionally small ant. The nearest sentry at once came up and inspected, and before the small ant finally got well away the egg twice or thrice became the object of inspection for three or four ants at a time; but she finally went off with it with the column.

I now left for half an hour. On my return things were much as I had left them, and none of the *Acraea* eggs had been moved. I decided once more to test the view that it was merely the small size of the eggs that was against them. I accordingly cut up two house-flies (*Musca domestica*) into fragments not larger than a *Papilio* egg (for example, the two eyes each constituted a different offering), and placed them in and near the run. Each piece at once became the prey of *several* ants, not merely of perhaps the fortieth chance passer-by as in the case of the accepted eggs, and all were quickly carried off. I added, each separately, the two eyes of a ♀ *A. caldarena*, and these were also taken. I then extracted its eggs (there were not very many) and laid them down as three or four little separate masses. The ants swarmed over them as over the previous offerings, but very speedily desisted and quickly covered them with small scraps of earth, after which they were persistently neglected. I noticed too that the earliest eggs in the experiment—the *laid* eggs of *A. caldarena*—had, earlier, also been placarded in the same way. I then laid down, in three pieces each, the abdomen and thorax of the *Acraea*. These were seized by quite a number of ants, as was a whole, wingless, dead *A. caldarena*, but were not carried far, each being abandoned after a trip of a few inches. They were not placarded, at any rate to any noticeable extent. In the general bustle the earlier *caldarena* and *acara* eggs became uncovered, and they and at any rate the larger of the remaining eggs came in for a good deal of additional attention, and the remaining green *ethalion* egg was quickly carried off, as also one of the yellow ones. One *hippocoon* egg disappeared now or earlier, but may of course simply have become hidden by loose earth; the other remained untaken throughout and eventually fell into some debris in a rut, and I was unable to recover it. I saw none of the small Nymphaline eggs taken, and was able to find more than half of them at the end. I added a *P. demodocus* and a *hippocoon* egg during the bustle, and these were after much delay taken, and an egg of either *Charaxes brutus* or *C. cithaeron*, which was visited by many ants, and though a relatively large and conspicuous object and brimming over with liquid was each time merely tried and left. A green *C. ethalion* which I added to it was taken practically at once, and eventually the larger *Charaxes* egg found a carrier too. The uncovered *Acraea* eggs found many visitors but never a carrier, and on my visiting the ants again the last thing in the evening remained uneaten and had been partly earthed up again.

Before discontinuing the experiment I had added one or two small, black orange-Aphides by themselves, and, in a mass on the twig on which I found them, a large number of others. They attracted a great deal of attention, but I was unable definitely to see that the ants "milked" them at all, as do some of our other ants, but a few of the usual warning earth-crumbs were placed on them.

May 2nd.—During the morning, again going to yesterday's side-column, I placed by it several eggs of *A. caldarena* and *A. acara*. They were subjected to a great deal of inspection, and finally earthed and neglected. A *Danaida chrysippus* egg which I placed right in the ants' path was inspected by very numerous ants but always at once refused. Eggs of *hippocoon* and *P. demodocus* were usually given longer consideration by the ants that stopped at them and, especially the latter, sometimes picked up, but were not taken. Of two *H. misippus* eggs only one, so far as I saw, was properly inspected, and it was refused. An egg of *E. hiarbas* was once or twice inspected and once picked up and put outside but not taken, and two or three eggs together of *P. cardui* were rejected. But a *C. ethalion* of yesterday's yellow brood was at once picked up by the first small ant that came to it and carried away. The larva, only just hatched and not yet having eaten, of *hippocoon* was passed over for some time and several times inspected and refused, but finally an ant took it and held it in one place for two or three minutes while passers inspected it (as in the case of the tick) before she finally commenced definitely to carry it. She was even then very undecided for a time, sometimes going on towards the next station ahead, then retracing her steps and going towards the main column and so on. Finally, she took the latter direction.

I kept moving the rejected eggs back as they became pushed or carried to the side, but without effect, though a fresh green *C. ethalion* egg that I added to them was at once taken and carried, and eventually an ant took the *P. demodocus* egg and, after what looked like much consultation, carried it off too. I now turned my attention to the main column, which was going strong, nine or ten abreast. I put in the *Danaida* egg. It was inspected and at once rejected by several ants, and at last put out to the side and well earthed up. A *P. dardanus hippocoon* egg was twice ejected, two eggs of *A. acara* were ejected after having been the subject of much inspection by individual passers-by, and earth-crumbs were placed against them. But a yellow *C. ethalion* egg was quickly picked up and carried to the nearest station.

On my bringing *Danaida* to the more active attention of the ants it was several times tried with the antennae and refused, the *hippocoon* egg, as well as a second that I added, was persistently ignored or ejected; the *P. demodocus* egg was tried and refused a few times, then found a carrier; of two *P. cardui* eggs put down, one was picked up very soon and carried along, the other remained ignored and possibly unnoticed; two eggs of *H. misippus* placed amongst the ants were overrun and gradually drifted to the side every time I brought them back. I did not see them tried. An *E. hiarbas* egg was picked up and ejected, as was, several times, an egg of *hippocoon* and one of *P. demodocus*; but a green egg, with dark ring, of *C. ethalion* was very soon picked up and carried with the column. I then killed, diswinged and put just inside the column a ♂ *D. chrysippus* and a ♂ *Acraea natalica*. Each was at once covered by a mass of ants and gradually brought into the line. Proceedings continued to be so slow that I had to leave, but on my return to inspect half an hour later or less both had completely disappeared.

May 2nd.—Afternoon.

This was really a larva experiment, but as eggs were used too, and as the use of freshly-hatched larvae is also obviously relevant, I ought perhaps to state the gist of it here.

Eggs of *A. acara* many times refused, one each of *hippocoon* and *P. demodocus* two or three times ejected, a just-hatched *P. dardanus* larva treated as in the morning, but a three-quarter-grown one with the final, most protective appearance at once set upon and carried off. Barely hatched *A. acara* larvae, still busy with their egg-shells, persistently refused and repeatedly ejected, but a half-grown individual of the same species killed and taken, as also quarter-grown *E. hiarbas* and *A. caldarena* larvae and a nearly full-grown *A. caldarena* larva.

The larger *Acraea* larvae gave the ants a good deal of trouble by exuding, when set upon, drops of the usual poppy-flavoured liquid from the ends of their bristles. They thus succeeded more than once in escaping from the column. I put them back, however, and the ants overcame the difficulty intentionally or incidentally by placing on the ends of the bristles crumbs of dry earth, which soaked up the liquid and enabled them to bite off the bristles lower down. Fresh drops appeared as the result of this, and fresh crumbs of earth were applied until finally the bristles were razed off level, in many cases, with the caterpillar's body. It was then set upon freely by masses of ants, killed and carried off. I at first believed that the application of the earth-crumbs was purely in the nature of "placarding" (which is still possible), but I felt before the end of the experiment that it might readily be, as I have described it, for the purpose of soaking up the liquid. I hope to repeat the experiment. The greater repugnance shown for the very young larvae is of great interest. It is in line with the dislike shown for the eggs, and perhaps explains the greater conspicuousness of certain newly-hatched larvae — for instance, those of *Papilio dardanus*. It is also in line with native statements about nestling birds (alleged to be in general less pleasant to eat than the adults), though this has not been proved to apply to other enemies than man.

In a weak column of ants elsewhere I had tested a few days previously larvae of *Acraea caldarena* (from a quarter to nearly full-grown) against larvae of *Precis natalensis* of the same sizes, also against a dull-coloured spider that I happened to catch on the spot. The *Acraea* larvae escaped by the use of the fluid secretion, but the *Precis* larvae and the spider were killed and carried off.

May 3rd.—Put down an *Atella phalantha* egg. Numbers of ants passed over it, but none stopped to examine. Finally it suddenly disappeared. It must, I think, have been picked up, but whether thrown out or carried along I could not ascertain. A second was for some time passed over unheeded in the same way, until suddenly a small worker picked it up, dropped it quickly just outside and passed on again. On my returning it, the egg was again passed over as before and remained untaken when I had to leave, a few minutes later.

May 6th.—Put down two eggs of *Charaxes candiope*, already lightly ringed. They were passed over and examined and neglected by a number of ants, until finally an ant examined one of them thoroughly, picked it up and going a few inches down the column turned into an out-jutting "creek" (so to speak) of ants, scrambled in amongst the others, possibly consulting, came out again and a few inches back the way she had come, then back again into the little conclave, out again and back yet again. On her emerging this time my attention was diverted to a prolonged examination that was taking place of the second egg, and I could not again trace the first, so am unaware of its eventual fate. I added two more *C. candiope* eggs to the second (the examination of which had ended in ejection from the column), also two eggs each of *P. demodocus*, *Atella phalantha* and *hippocoon*, and four or five (together) of *A. acara* (dark with incubation). I watched for a long time and, though many examinations and one or two apparent consultations took place, none of the eggs were taken, and the larger ones usually ended in being ejected each time I put them in. I then put down an egg of *C. ethalion*, with a ring and slightly incubated. It was very soon picked up and carried along to a tunnel, but a second of the same date received much the same treatment as the other eggs.

The above took place in the orderly bustle of a marching column. I next went to the head of a column some distance away, where the ants were well scattered out over a wide area, searching, and put down on a stone they were crossing two eggs of *C. candiope*, one of *hippocoon*, one of *P. demodocus* and one of *A. phalantha*. They were many times examined but never taken. I added an egg of *C. ethalion*, and after being examined and left, like the others, a few times, it was picked up and carried for a distance, then put down. On my replacing it, this egg (and none of the others) was soon picked up once more and carried away. I now kept trying to bring a *C. candiope* egg to the notice of the ants and it was always refused though often examined, but a *C. ethalion* (very hard-set) was then treated similarly. There were very few ants here now, and I next went on to experiment at a spot where they were covering the ground fairly thickly, and put down an egg of *C. candiope*. This was set upon by several ants, but they shortly desisted and left it, and treated similarly two more eggs of the same species. A *P. dardanus hippocoon* egg, a *P. demodocus* egg, an *A. phalantha* egg and eggs of *A. acara* were also all refused, as was the about-to-hatch *C. ethalion* egg. The ants were already becoming thinner again at this point, so I moved the eggs and added a fresher *C. ethalion* egg, marking the place. I left, and returned ten minutes later to find that the ants had shifted on again, leaving all the eggs as they had been put down by myself.

I decided at this point to discontinue the experiments. I had not the animals for the far more extensive series of experiments that I still hope to undertake, and the ants' reply to the question asked of them had been in any case of a sufficiently consistent nature so far as they themselves were concerned. In spite of their rather catholic tastes, they had evidently found all the eggs offered them—at all events all they definitely tried—rather highly unacceptable, but not quite equally unacceptable. I am inclined to state as follows the grades that were indicated :—

(1) *Pseudacraea lucretia* var. *expansa* and *Charaxes ethalion.*
(2) *Papilio demodocus.* } *Charaxes cithaeron.*
(3) *Papilio dardanus.* }
(4) *Acraea acara*, *A. aglaonice*, *A. caldarena* and *Danaida chrysippus.*

Pyrameis cardui eggs would appear from at least one experiment to be preferred to those of *P. dardanus*, but they cannot, I think, be very *much* higher. *Hypolimnas misippus* and *Eurytela hiarbas* eggs would appear to be as low as that of *P. dardanus*, but the extent to which they were genuinely tried seems doubtful.

The eggs tested cover quite a considerable range of appearance, and this, with the fact that when we ourselves search for it with the closeness that is habitually employed by its natural enemies we have relatively little difficulty in finding the average leaf-laid egg, at least suggests that it is not amongst such eggs but amongst those that are concealed in earth, stems, etc., that we must look for the higher grades of palatability. The inference that it was through repugnance to them that the ants avoided the eggs was confirmed by their repugnance to newly-hatched larvae as compared with older ones.

3. Experiments on Cockroaches, a Cricket and a Coccinellid.

April 28th, 1913.—Early in the day I placed in a small gauze-covered box with two live larval cockroaches thirteen eggs of *Acraea aglaonice*, twelve of *Acraea caldarena*, ten of *Pyrameis cardui* and three of *Papilio dardanus* ♀ f. *hippocoon.* None had been eaten by evening, and during the evening the cockroaches escaped. I replaced them at about 10 p.m. in the evening by two adult and three larval cockroaches of the same species.

I left in another small box with a female of the carnivorous ladybird *Alesia bidentata* a number of eggs of *A. caldarena*, three of *hippocoon* and one of *P. cardui.*

[Cockroaches were of our common Gazaland species.]

April 29th.—No developments in the cockroach box. In the other box the *Alesia,* instead of eating the egg, has merely added to them one of her own. It is laid beside the *Acraea* eggs on a small bit of green *Wormskioldia longipedunculata* leaf.

April 30th.—Removed the eggs supplied to the *Alesia*, since she continued to refuse them, and placed them in a gauze-covered box with a carnivorous cricket (*Arytropteris* sp.).

May 1st.—No developments in the cockroach and cricket boxes except that the former insects, while still ignoring the eggs, had eaten a portion of a dead companion.

Later.—The cockroaches and cricket persisted in refusing the eggs, not only when unbroken but when damaged by a pin-point. One actual tasting followed by a rejection took place on the part of one of the cockroaches, and eggs extracted from a *hippocoon*'s body were refused. But both cockroaches and cricket ate other food that I eventually offered them, including eggs extracted from small dull-coloured grasshoppers.

Concluding Remarks.—The experiments, were they made on better-chosen enemies, would suggest that openly-laid lepidopterous eggs, generally, are somewhat highly protected by some such quality as nauseousness, though in varying degrees. It was interesting that the egg most frequently taken was a leaf-green one.

As it is, the experiments are open to criticism. Yet they suggest that experiments on visually-discriminating egg-enemies may be well worth carrying out. So far as the parasitic Hymenoptera are concerned, facts have been recorded showing that some, at any rate, of these do *not* recognise eggs visually.

Should further experimentation produce the results that I am inclined to expect, the study of the appearance of insects' eggs is likely to be a very fascinating one. Nor will it be entirely dependent on the obtaining of the food-plant. Thus I have compared the *laid* eggs of quite a number of different species of butterflies with the most advanced eggs still in the bodies of the gravid parents, and I have found that in each case the eggs about to be laid corresponded well in colour and form with newly-laid eggs.

Against this we have the fact that newly-laid eggs—and therefore also eggs extracted from the parent's body—do not necessarily give an accurate idea of what will be the coloration of the egg during the greater part of its existence as such; for many eggs (as those of *Papilio* and

Charaxes) do not attain their full coloration for a day or two after laying, and they darken again when approaching hatching. Yet even here something may be done; for I have found (my observations here being confined, however, to species of the three genera *Pseudacraea*, *Charaxes* and *Papilio*) that a gravid female at death usually contains one fertile unlaid egg, and that this egg, but not the others, goes through its colour-changes within the parent's body (or if extracted from it) just as it would have done after laying, and ends (if the parent's drying be not too rapid) in actually hatching therein. I have taken a live larva, half out of its shell, from the body of a long-dead *Pseudacraea lucretia* var. *expansa*, and it has fed freely when placed on *Chrysophyllum fulvum* (its food-plant in the Chirinda forest) and has quickly proceeded to cover itself in the normal manner with its own frass.

The one fertile egg has of course another obvious application. It may enable us to study the life-history of an insect that has proved refractory about laying. I have bred *Papilio dardanus* from such eggs, and the *Pseudacraea* larva referred to above was already more than a week old and strong and vigorous when it was unluckily accidentally killed. I have, I believe, twice obtained more than one such egg (in each case from a dead *P. dardanus* ♀ f. *hippocoon*) as against more than thirty instances in which there was only one.

[For Mr. Swynnerton's further notes on the eggs of butterflies see Supplement, p. 428.—E. B. P.]

FURTHER NOTES ON THE EGGS OF BUTTERFLIES.

A Supplement to C. F. M. SWYNNERTON'S Memoir XIV (p. 317), *Experiments on some Carnivorous Insects*, etc.

I HAVE made a point of making coloured drawings of any butterfly eggs that I have been able to obtain, *as seen against their usual natural background*; for it is only in this way that their relative conspicuousness can be assessed. I had hoped to incorporate these drawings in a plate to be published with this paper; but, although this has proved to be impossible, it is worth repeating that the conspicuousness of many of these eggs relatively to the point of vision of the closely-searching bird is very great indeed. The contrast of the ivory-like eggs of *Danaida chrysippus* with the commonly quite dark green leaves of the species of *Asclepias* on which it feeds, and that of other Danaine and Acraeine eggs—bright yellow or whitish and before hatching purplish brown—with the leaves of *their* food-plants is quite marked. This conspicuousness is furthermore often much enhanced by the eggs being laid many together. To watch an *Amauris*—slowly, deliberately and with carelessness of attack—laying her eggs one after another on a highly-exposed leaf of *Cynanchum*, the eggs themselves more or less closely spaced and visible to the observer ten feet away, must convince any one who knows the hurried laying of some other butterflies of the existence of special protection.

Eggs of certain species are, of course, laid sometimes on the upper surface, sometimes on the lower, of a leaf, sometimes on the petiole or a twig; and the degree of conspicuousness varies accordingly. An egg laid under a leaf should commonly be fairly visible to searching birds which make a point of minutely examining the undersides of leaves; but its appearance there, in relative obscurity and seen against the light, is naturally somewhat different from what it would be under other circumstances. Yet it is often conspicuous enough as a darker object than the rest of the leaf, for the under surface generally receives enough reflected light from the sunlit ground or other leaves below to make the egg's detail easily visible.

The eggs of *Pyrameis cardui* (blue-green), *Antanartia schoeneia* (grey-green) and *Eurytela hiarbas* (glassy, slightly yellowish green) are all less contrasted with the leaves of their respective food-plants than are the eggs of the *Danainae* and *Acraeinae*. They do not at once catch the eye as these latter are apt to do, and, by the careless searcher or when not looked at directly, may often be passed over. Yet, searched for well, even these are very fairly visible, and I have noticed that the eggs of *Antanartia* are somewhat particularly so when laid beneath a leaf. In hairiness (shared with *Byblia*) the *Eurytela* egg resembles that of its food-plant at Chirinda. This certainly aids in such concealment as it enjoys, yet, when the egg is detected, this same hairiness gives it great distinctiveness.

A very beautiful egg, if a small one, is the clear cut-glass egg, just tinged with green, of *Hypolimnas misippus*, in fair contrast to the leaf of *Portulaca*. A curious egg is that of *Pseudacraea lucretia*, a half-sphere with a bubbled or honeycombed appearance due to the occupation of the whole exposed surface by closely packed depressions. It is perhaps less in contrast with the peculiar russet or silvery underside of the leaves of its food-plants (*Chrysophyllum* spp.) than a considerable proportion of butterfly eggs are with the coloration of theirs. The green egg of *Charaxes ethalion*, which, with the *Pseudacraea* egg, seemed to be the most readily taken by the ants, matches the green of its food-plant (*Albizzia*) better than any egg I know, especially just at first. Later it develops its ring, a dark brown one, and it then looks not very unlike the extra-floral nectaries of *Albizzia chirindensis*. I have not examined those of typical *Albizzia fastigiata*, its food-plant in Natal. In any case the resemblance, such as it is, is unlikely to have been the result of selection, as the ring is a common feature of *Charaxes* eggs, and even enemies that are easily deceived or are looking carelessly would learn to distinguish the egg from the nectary by its different position on the leaf. I have seen one or two broods of *C. ethalion* (out of a large number) in which the eggs were yellow instead of green.

The strong ringing of the egg of *Papilio dardanus* is perhaps a little more notable, though a *tendency* in that direction occurs in other Papilionine eggs at Chirinda.

Like these, it starts as a light yellowish-green egg, conspicuous through being so much paler than the various Rutaceous leaves on which it is laid—*Teclea*, *Toddalia*, *Vepris*, *Clausena* and *Citrus* of all species. It shortly changes into a dull whitish egg with an irregular purplish or brown-madder ring round its greatest circumference and a dark spot in the centre. There is now a superficial resemblance to the egg of *Charaxes brutus*, though the ring of the latter eventually attains a deeper colour and the shape of the egg is a little different, that of the *Charaxes* having the usual depressed and slightly sculptured top characteristic of the eggs of that genus. An ordinary hand-lens makes the difference clear, and it is probable that such a lens gives us much the appearance seen by the small, closely-peering warbler or white-eye. In *P. dardanus*, as in *C. ethalion*, I have seen a single brood (out of many) in which the eggs, after developing their ring, were yellow, and looked very like those of *Charaxes candiope*. In two broods the eggs were unusually small—more like those of *P. demodocus*.

The resemblance of the eggs of *Atella phalantha* to those of one or two of our commoner Acraeas is even stronger, though the common appearance is again brought about by a common colour and general shape with a somewhat different sculpturing. Apart from the fact that *Atella* is not so very far removed from the *Acraeinae*, we need to know whether all *Atella* eggs are like those of *A. phalantha*. It is early days to suggest mimicry when we do not yet know whether the egg-enemies that recognise by sight discriminate as did the drivers. Nevertheless, the latter's refusals show that a *potential* basis for preference certainly exists, so that the possibility of mimicry is at any rate worth bearing in mind; and the results from the drivers, if they should be more generally applicable, suggest that if there should happen to be mimicry in any of the above resemblances, mnemonic considerations may have contributed to it in even greater degree than differences in grade. I have already suggested, elsewhere (Proc. Ent. Soc. 1915, p. xlii), that such considerations—the principle of increased reminding-power and facilitated recognition—and not Müller's principle of the shared loss, are the real basis of numerical mimicry.

June 2, 1916.

XIV. *On the Scent Apparatus in the male of* Amauris niavius, *Linn.* By H. Eltringham, M.A., F.Z.S.

[Read March 19th, 1913.]

Plate XX.

In 1877 the late Dr. Fritz Müller published a paper "On the Sexual Spots of the males of *Danais erippus* and *D. gilippus*." * He there describes the pockets in the hind-wings of these insects as lined with special scales, and at the same time gives figures of these structures and of the extrusible brushes situated in the anal region. At the end of this account he makes the remarkably ingenious suggestion that the insects may insert the brushes into the pockets and so impregnate the former with the scent material therein secreted. It remained for that acute observer, Mr. W. A. Lamborn, actually to see a similar process taking place in a species of an allied genus, *Amauris.*†

Mr. Lamborn first observed the action in *Amauris niavius* in 1911, and early in the following year noticed the same habit in *Amauris egialea.*

In this genus the scent patches are not in the form of pockets but are merely specialised portions of the hind-wing, and Mr. Lamborn was fortunate enough to see the butterfly stroking the patches with its brushes.‡

Actual confirmation of Müller's suggestion having been obtained, it occurred to me to examine minutely the structure of the brushes and scent patches in a species of this genus, and *Amauris niavius* was chosen as being the most easily obtainable.

One of the first difficulties in an undertaking of this kind is to obtain material in a proper state of preservation, and after preliminary experiments with some of our native species of butterflies, I found that good sections could be obtained from specimens treated while fresh with a strong solution of corrosive sublimate to which a little acetic acid has been added.

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* Archivos do Museu-Nacional do Rio de Janeiro, II, pp. 25–29, 1877. English translation by Elliott in Longstaff's "Butterfly Hunting in Many Lands," Appendix, p. 616, 1912.

† Proc. Ent. Soc. Lond., pp. xlvi–xlvii, 1911, and p. xxxv, 1912.

‡ It is interesting here to recall Prof. Poulton's exhibit recorded in the Proceedings of this Society, p. x, 1907, when an example of *Amauris egialea* was shown having had the scent patches completely eaten out by ants.

I am greatly indebted to Mr. W. A. Lamborn and Mr. C. A. Wiggins for a supply of material taken by them and preserved in this manner.

I would also express my thanks to Prof. Poulton and to Dr. Dixey for much kind assistance and also especially to Mr. E. S. Goodrich, to whose skill I owe the discovery of the minute pores in the peculiar structures presently to be described.

The scent patches on the wings.

The scent patches occur in the form of two small somewhat oval patches, one on each hind-wing, situated on the more distal half of the submedian nervure (see fig. 2). They differ in texture from the remainder of the wing surface in having a smoother and somewhat greasy appearance. The nervure is greatly swollen where it traverses this patch, and the patch itself is many times thicker than the normal wing membrane.

The scales covering the latter are exceedingly difficult to remove, ordinary mechanical means merely breaking without actually dislodging them.

Microscopical examination of the wing shows that over the greater part of its area the scales are arranged as in Pl. XX, fig. 3. Long and short scales alternate, the former generally overlapping the latter, though there is occasionally some little irregularity in this respect. The scales which cover the scent patch are much smaller and are represented in fig. 4. They are more rounded and are all of the same shape and size. If a portion of the scent patch be denuded of scales and examined under a high power, we find an appearance which is semidiagrammatically shown in fig. 5. The upper surface of the wing is seen to be covered with comparatively large rounded bodies, the length of which is slightly in excess of the breadth. Each appears to have a somewhat thickened edge and has in its centre a minute opening. Between these structures lie the scale sockets from which arise the special scales already mentioned. In the figure the position of the scales is indicated by dotted lines, from which it will be seen that each scale serves as a cover for one of the rounded projections. Fig. 12 shows the appearance of a transverse section of this portion of the wing. On the upper surface the rounded bodies protrude some distance from the wing membrane and their outer surfaces are closed by a thin chitinous covering, each pierced by a minute pore.* Although provided with a covering, we may for convenience call these structures the scent cups. Between each pair there lies a scale socket. The space between the wing membranes is principally occupied by large cells, which are greatly distended with globules of material having a fatty appearance. If the specimen has been treated for a short time with eau-de-javelle, this substance is dissolved and the space they occupied is represented by large irregular vacuoles. If a section be taken to include the nervure, it is seen that close to the nervure the secretion is so plentiful as to cause a forcing apart of the wing membranes. I have shown such a section in fig. 13, though I am inclined to think that the membranes would not be so widely separated in nature, and that the tissues have been partially torn or expanded by the processes of preservation and embedding. Beneath the secreting cells is a basement layer from which arises a network of connective tissue forming septa. As the scale sockets lie between the scent cups, strands of this connective tissue appear in section to proceed direct to each scale socket. It is not clear whether these have a direct connection with the sockets, though there does appear to be a small nuclear body beneath each socket.

Reverting to fig. 13, the section of the nervure shows a lining of large cells surrounding a granular area which encloses a large lumen. The latter may well be an air vessel, the granular portion being vascular, and we may suppose that the large cells are in some way intermediaries between the circulating fluid and the secreting cells of the wing patch.

Fig. 10 shows a section parallel to the plane of the wing. The secreting cells are seen to form small glands enclosed in a network of connective tissue. Each gland presents a slightly granular appearance and shows a varying number of nuclei. Scattered globules of the secretion are also seen. It should here be noted that Dr. F. Müller and later, independently, Dr. F. A. Dixey, discovered in Satyrines and Pierines, respectively, special distributions of tracheae in connection with the scent patches in butterflies belonging to those genera. I have not found such structures in *Amauris niavius.*

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* I was for some time under the impression that these structures were in the form of open cups. I am indebted to my friend Mr. E. S. Goodrich, F.R.S., who happened to see some of my sections, for pointing out their true structure.

The abdominal brushes.

The position of these in the body of the insect may be understood from fig. 1, which represents a dissection of the genital armature viewed from above, with the brushes *in situ.* In the lower part of the centre of the figure is seen the penis, with its two great extensor muscles, passing through the proximal dorsal membrane of the uncus. The latter is a large arched chitinous plate with a prominent ridge in the centre of its dorsal surface, and on either side of this ridge lie the brushes. Each brush is contained in a membranous bag, the proximal end of which is provided with a muscle attached to one of the sternites. The hairs of which the brush is composed arise mainly from the proximal end of the bag. The membrane at the opening of the latter is continuous with the lining membrane of the tergite. The bag is everted, doubtless by means of fluid pressure, and the process may be compared with the turning inside out of a glove finger. The brush hairs then project from the posterior end of the insect, forming, when completely everted, a more or less spherical tuft. The whole apparatus can be withdrawn by the contraction of the retractor muscles shown in the figure. A microscopic examination of the brushes and their containing membranes reveals the following structure. The hairs of each brush are in two tufts. One, the larger, is composed of yellowish hairs, the sockets of which are placed at the base of the bag. The second tuft consists of black hairs arising from similar sockets placed somewhat more distally and on one side of the bag.

Fig. 8 shows a section of the brush bag at its base. The hairs arise from a thick layer of elongated cells having nuclei at their bases and chitinous sockets at their extremities. Fig. 6 shows three of the hairs with cells attached. The only difference I can find between the dark and pale hairs, beyond that of colour, is that the former appear to be somewhat stiffer. Both have the distal ends rounded and often somewhat clavate. Their surface is longitudinally ribbed, and in section they have the appearance shown in fig. 7. Seen by transmitted light the hairs have reticular markings as shown in fig. 6.

We now come to the most peculiar structures in this complicated organ. If a brush be examined in section the spaces between the hairs are seen to be packed with very minute particles which have a stellate appearance when occurring singly, but which may also appear as elongate bodies covered with projections. If a brush be removed from a dried specimen, teased out on a slide and examined dry, with a very high power, the whole field is strewn with these objects, which then present the appearance shown in fig. 9. In sections mounted in balsam they appear to be smoother and are much more difficult to see.

These particles arise from a special layer of cells forming the middle portion of the lining of the brush bag. Part of this layer is shown in fig. 11. The cells are very similar to those which produce the hairs of the brush except that they are much smaller. They terminate in chitinous sockets from each of which protrudes a delicate thread-like growth, the free end of which appears to be obtusely forked. In balsam-mounted specimens it is very difficult to observe any segmentation in these filaments, though from the appearance of dry preparations I am convinced that they are segmented. It seems probable that the cells are in fact modified hair-producing cells and that the delicate hairs to which they give rise have a stellate section, and further that they divide transversely into a multitude of minute particles. The stellate appearance may also be due in part to the splitting of the hair at the broken edge.

We may now compare the whole scent apparatus with the corresponding structures in *D. erippus* and *D. gilippus*, as described by Müller in the paper already referred to. Highly magnified sections of the brushes and wing patches are not given, but the author figures and describes views of the inner membrane of the wing pockets of both these insects. The figures would seem to show that there are cup-like projections much as in *A. niavius*, and scales arising from sockets placed between them.

We may here quote Dr. Müller's description. "In *D. erippus* it [the patch] exhibits small circles of about

0·01 mm. diameter, a little more transparent than the rest of the membrane. From the centre of each rises a straight hair, about 0·06 mm. long. The circles are placed in regular lines, about 0·03 to 0·06 mm. apart. Alternating with these circles are opaque grey scales, distinguished from the ordinary ones by their smaller size and by their shape.

In *D. gilippus* the circles are much closer together—so much so that in places they almost touch; although more transparent than the rest of the membrane, they are less so than those of *D. erippus.* The hairs are wanting, but one sees in the centre of each circle a small spot, the last vestige which proves their former existence."

Müller regarded these "small circles" as scale sockets. The evidence for this view is very strong, since in *D. erippus* hairs still arise therefrom. In the Pierine butterflies, as we know from the researches of Dr. F. A. Dixey, the special plume scales themselves act as distributors of the scent which passes into the substance of the scale through the footstalk. We may therefore with some degree of confidence regard the scent cups in the wings of *A. niavius* as highly specialised scale sockets, the pore in the centre of the cover being the vestige of the insertion of the scale stalk and now functioning as an exit for the secretion of the gland cells.

We may suppose that the insect brushes out the secretion, the stiffer hairs probably assisting in lifting the covering scales, which are specially adapted to withstand this treatment. It should be noted that these hairs are on the outer side of the brush, and would thus naturally come first into contact with the scent patch. The completely expanded brush then diffuses the scent. The ribbed structure of the hairs probably serves not only to increase their surface, but also to aid in the retention of the secretion.

It still remains to explain the purpose of the stellate fragments which occur in such profusion in the brush bags, and for the production of which so many special cells exist. The most probable explanation appears to be that they float off the brushes during flight and carry the scent, thus diffusing it to a greater area around the insect than could be accomplished by the brushes alone.

The occurrence of hairs which split transversely into fragments is not unknown in connection with analogous organs in other Lepidoptera.

In another paper [*] Dr. Müller has described such hairs as being present in the costal fold of the wing of certain male *Hesperidae*, such costal folds being undoubtedly scent organs. Just recently I have found in the brushes of *M. mercedonia*, particles of a similar nature to those found in *Amauris*.

The investigation of which the foregoing is an account was completed before I had had an opportunity of examining Freiling's account of the morphology of the brush hairs in *Euploea asela* and *Danaida septentrionis*.[†]

Freiling is of opinion that in these species it is the brushes themselves which produce the scent. Excellent figures are given showing glandular cells from which the brush hairs are developed, and also drawings of the hairs showing pores in their walls through which he supposes the scent material, produced by the glandular cells, to be discharged. I have not yet succeeded in obtaining suitable material to enable me to confirm this author's results. The hairs of the brush in *D. septentrionis* are of a quite different structure to those in *A. niavius*. So much can be seen from hairs taken from a dried specimen, but the existence of pores is not very obvious.[‡] The species has a scent pocket in the hind-wing, but Freiling seems to have been unaware of the connection between the scent pockets and the brushes in these Danaines. I have no desire to throw doubt on his results, which have evidently been obtained with great care and a mastery of technical skill. The abdominal brushes may in some species produce the scent, but I am not satisfied that in *A. niavius*, at any rate, they have more than a mechanical function. Freiling makes no mention of the filamentous hairs which I find in *Amauris*.

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[*] "On the costal fold of *Hesperidae*." Archivos do Museu Nacional do Rio de Janeiro, III, 1878, pp. 41–50. English translation by E. A. Elliott in Longstaff's "Butterfly Hunting in Many Lands," Appendix, p. 640, 1912.

[†] "Duftorgane der weiblichen Schmetterlinge nebst Beiträgen zur Kentniss der Sinnesorgane auf dem Schmetterlingsflügel und der Duftpinsel der Männchen von *Danais* und *Euploea*."—Zeit. f. wiss. Zool., pp. 210–290, pl. 12–17, 1909 : H. H. Freiling.

[‡] From an examination of the dry brush hairs in some other species of *Amauris* I am inclined to think that pores do exist in the brush hairs of some species. I hope soon to have suitable material to enable me to make a more exhaustive study of this and other interesting features.

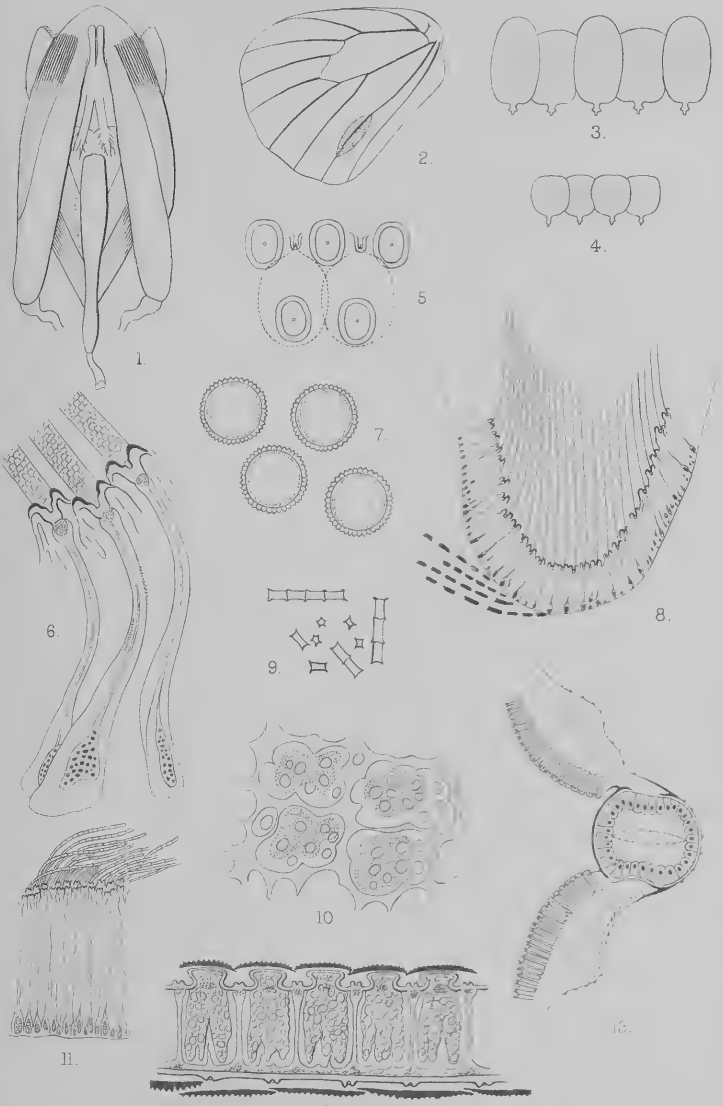
Perhaps these structures are peculiar to that genus. The whole subject is one of great interest, and the present paper is merely preliminary to the further investigation of other brush-bearing species, the material for which I hope shortly to receive.

EXPLANATION OF PLATE XX.

(*See Explanation facing the* PLATE).

EXPLANATION OF PLATE XX.

FIG. 1. Genital armature viewed from above with brushes *in situ.* × 10.
2. Diagram of hind-wing showing position of glandular patch. × 1.
3. Ordinary scales of wing. × 160.
4. Scales on patch. × 160.
5. Diagram of relative position of chitinous projections and their covering scales. × 300.
6. Large hairs of brush with elongated cells attached. × 300.
7. Transverse section of large hairs. × 750.
8. Longitudinal section of brush showing hairs arising from sockets. At left is shown a small portion of retractor muscle. × 135.
9. Filamentous hairs breaking into fragments. × 750.
10. Section of glandular wing patch parallel to plane of wing. × 450.
11. Cells of central portion of brush bag producing filaments. × 300.
12. Transverse section of wing patch at right angles to direction of nervure. × 300.
13. Ditto in way of nervure showing accumulation of secretion. × 50.



H. Eltringham del.

West, Newman lith.

SCENT ORGANS OF AMAURIS NIAVIUS.

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IV. *Further Observations on the Structure of the Scent Organs in certain male* Danaine *Butterflies.* By H. Eltringham, M.A., D.Sc., F.Z.S.

[Read December 2nd, 1914.]

PLATES XI–XX.

On a former occasion * I described at some length the structure of the scent-glands and brushes in the Danaine butterfly *Amauris niavius*, Linn. I am greatly indebted to my friends Mr. W. A. Lamborn, Mr. J. C. Moulton, Lieut.-Col. Manders, Mr. S. A. Neave, Mr. C. A. Rogers, and Mr. C. A. Wiggins for further material in the form of butterflies suitably preserved, enabling me to cut sections and investigate the structure of similar glands in other species. I am also much indebted to my friends Prof. E. B. Poulton and Dr. F. A. Dixey for kindly looking over the proofs of the present paper. It may be useful to recall that in the case of *A. niavius* the scent-glands were found to be located in the patch on the hind-wing submedian nervure. Each gland consisted of several cells communicating on the upper surface of the wing with a projection which I called a "scent-cup." This structure was provided with a cover pierced in the centre by a minute pore. Each scent-cup was also protected by a small scale, differing from the normal wing-scales in size and shape.

The two brushes situated in the hinder end of the abdomen consisted of tufts of chitinous hairs † arising from trichogenic cells in a membranous sac, the eversion of which by fluid pressure causes the extrusion of the brush. In addition to these structures it was found that a certain area of the brush-bag contained cells which produced numerous delicate chitinous filaments, these having the property of breaking up transversely into innumerable tiny particles, thus forming a kind of dust, the suggestion being that these particles assisted in the diffusion of the scent.* Reference was also made to the fact that these butterflies are known to apply their brushes to the patches on the wings.

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* Trans. Ent. Soc. Lond., p. 399 *et seq.*, 1913.

† It has been pointed out to me that the insect structures commonly referred to as hairs are not hairs in the true morphological sense, and of this I am, of course, aware. At the same time, when speaking of hairs in connection with insects, we mean insect hairs or the hair-like structures (setae, modified scales, etc.), which are found on insects, and I do not think that any confusion need arise on this point.

Having thus briefly reviewed the conclusions already attained in my previous paper, I propose to describe the corresponding structures in certain other species of butterflies, and it will be seen that complicated as is the arrangement in *A. niavius*, differentiation has reached an even higher development in other forms. Neither wing-glands nor dust-producing devices are invariably present; the brush itself and not the wing may produce the scent material, or at least exhibit a glandular structure, whilst the dust may be produced by the wing and not by the brush, and in the pupal instead of in the imaginal state.

I propose to describe each species separately, after which the results may be considered.

Amauris psyttalea, Plötz.

Of this species I have had only one body to examine. It was sent to me by Mr. C. A. Wiggins, who did not then understand that I required the wings as well. I am thus unable to describe the wing-brands except from such information as can be gathered from the examination of dried examples. From these, however, it is clear that the arrangement is very similar to that in *A. niavius*. Regular rows of "scent-cups" are seen, each covered by a small scale arising from a socket placed between two of the scent-cups in the adjacent row. The scales resemble those in *niavius*, though they are slightly less rounded. The glands are probably similar to those in *niavius*. From the single abdomen available I was able to make both transverse and longitudinal sections of the brushes, and these proved extremely interesting. From the base of the brush there arises a pencil of hairs corresponding in every way with the "yellow hairs"* in the brush of *niavius.* Pl. XI, fig. 1, is a photograph of a section of the brush near the base. It will be noted that there are a few small dark-coloured hairs near the middle. These resemble similar hairs in the brush of *A. whytei*, but they are fewer in number and much shorter. A little further from the base the brush-bag becomes deeply convoluted on its inner side and bears great numbers of small cells, from which arise delicate filaments similar to the "dust-hairs" in *A. niavius.* Pl. XI, fig. 2, is a photograph of a section across this area. In the latter species these dust-hairs, though numerous, are almost insignificant compared with their development in *psyttalea.* In the latter they form the most conspicuous feature of the brush, and are produced in enormous quantities. They arise from cells all round the brush-bag, and in section they form a dense ring enclosing the yellow pencil. Pl. XI, figs. 3 and 4, show the appearance of sections of the brush near the middle, and towards the outer end, respectively. The dust-hairs extend to the end of the brush, where they show the same tendency to break up into particles. From an area some little distance from the basal end of the bag there arise the black hairs similar to those in *niavius.* These can be seen in figs. 3 and 4.

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* This idea of the function of the dust particles was in part due to the suggestion of my friend Dr. Karl Jordan, a fact which I regret I omitted to acknowledge in my previous paper.

The prolific production of dust material in *A. psyttalea*, as shown by microscopic examination, is interesting when considered in conjunction with Dr. Carpenter's observations on the courtship of the species. Dr. Carpenter's note was read by Prof. Poulton at the meeting of the Society on December 2nd, 1914, at which I exhibited photographs of sections of Danaine scent-organs illustrating the present paper. His remarks were as follows :—

"On July 21 [1914] at the edge of the forest here on Kome Island, about 5 p.m. I saw the courtship of *Amauris psyttalea*, Plötz. I noticed two flying about, obviously a male pursuing a female. Presently the latter settled on an erect dead flower-spike of an aromatic Labiate, about two feet above the ground. She sat with head upwards and body perpendicular, wings outspread at right angles.

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* I have referred throughout to these hairs as the "yellow hairs," since they are of that colour in all my preserved specimens. As Dr. Carpenter, in the observation quoted below, speaks of them as "quite white" in the living insect, I conclude that they become yellow after immersion in preservatives.

The male hovered flutteringly about four inches over her head, rising and falling a little, but on the whole at about the same level. His abdomen hung down a little, and every now and then at intervals of a few seconds the two flaps [the male claspers, especially large in Danaines] at the end of the body were widely separated (so as to stand out at right angles to the long axis of the body), and the brush was quickly protruded and as quickly drawn in again. I was surprised to see what a large structure it was, being quite white and visible at a distance of several yards. In fact, I first noticed it at that distance and went closer to see what was going on. The female sat quite still except for an occasional slight movement of the wings. I watched for a minute or so, and it was impossible to doubt that the male was endeavouring to excite the female. Just as I thought I would catch them as records, the female suddenly flew away and the male followed. I have, however, no doubt of the species.

"The very sudden protrusion of the brush might easily cause the peculiar fine hairs of stellate section, described by Eltringham, to break into sections which would float like dust in the air."

There can be no doubt that the dust material plays an important part in the courtship of these insects. Pl. XI, fig. 5, is a photograph of a very small area of a slide which has been dusted with a brush taken from a dry specimen. The filaments which form the dust are very similar to those found in *A. niavius*, but in transverse section whilst presenting an irregular outline, appear less distinctly stellate. They arise from very deep sockets, and communicate with their respective hypodermal cells through fine canals which traverse the chitinous membrane of the bag. They seem not to break into such very short pieces as the *niavius* filaments.

Amauris egialea, Cram.

The structure of the wing-brands in this species differs in several details from that found in *A. niavius*. Pl. XVIII, fig. 3, shows the shape of the normal scales as compared with those found on the scent-patch. The latter, one of which is shown in the figure, are considerably elongated instead of rounded as in *niavius*; moreover, they do not closely cover the glandular area. Pl. XVIII, fig. 4, shows a semidiagrammatic view of a portion of the brand viewed from above, from which it will be seen that the rows of scent-cups, indicated by dotted circles, are separated by glandular areas without cups, whereas in *niavius* there were no such intermediate rows. As a result of this formation, a transverse section of the scent-patch taken parallel with the general direction of the nervures has a quite different appearance from a section taken at right angles to this direction. Pl. XVIII, fig. 1, shows a section parallel with the nervures. On the upper wing surface the scent-cups are seen, each with its gland consisting of a few more or less vacuolated cells with prominent nuclei. The scales are rather thick and apparently solid. It should be noted that the glandular cells are short and do not reach to the ventral or lower wing-surface, thus leaving a space which is possibly filled with fluid during life. Alternating with these cupped glands are what may be termed " blind glands," formed of cells resting on a mass of material which is preserved in the section and presents a horizontally striated appearance. That this is really a mass of material, and not a membrane, is proved by the fact that its appearance is continuous in consecutive sections in whatever direction they may be cut. It presents the same appearance in sections cut in planes at right angles to each other.

Pl. XVIII, fig. 2, shows a section transverse to the nervures and through a row of the cupped glands. The difference in wing thickness is due to the section having been taken nearer to the edge of the patch. Also, the glands being somewhat flattened, they appear broader in this section. In all other respects the structure of the glands appears to be the same as in fig. 1.

The abdominal brushes are situated as in *A. niavius*, and are similar in so far as they consist of chitinous hairs arising from the lining of a membranous bag. They are everted by fluid pressure in the body cavity of the insect, and withdrawn by means of a muscle attached to the proximal end of the bag and to one of the ventral abdominal plates. The structure of the brush is, however, very different. When dissected out it is found to be of a fairly uniform thickness up to within about 1 mm. of the proximal end, where it is somewhat sharply constricted and, for the remainder of its length, considerably narrowed. From this constricted portion there arise structures which are very different from the well-rounded hairs more commonly found in these brushes. They are presumably in a more primitive condition, resembling thick scales of irregular section and comparatively great length. They arise from cells with chitinous sockets quite similar in appearance to those giving rise to the other hairs or scales, but above the stalk they are abruptly expanded so that their mean diameter is much greater than that of the sockets from which they arise. The base of the brush is composed of these structures only, and in the retracted condition they form a central cone, lying in the heart of the brush and ending in a point at about two-thirds of the distance from the base of the brush to its extremity. These bodies readily take stains such as haematoxylin and carmine, and are not chitinised to anything like the same extent as other portions of the brush. Pl. XVIII, fig. 5, shows a section of one of these structures as seen under a very high power. It is evident that the shape is such as to increase as much as possible the surface area. Moreover, I am inclined to think, after careful examination, that numerous pores exist in the surface, so that it is reasonable to suppose either that some secretion is discharged therefrom, or that they serve as a store for the secretion extracted from the wing-glands. There is, however, no direct evidence of their function.

Pl. XII, fig. 1, is a photograph of a section of the brush, where it consists solely of these structures. The membrane of the brush-bag is here very thin and contains many small nuclei. Pl. XII, fig. 2, shows a section taken a little above the constricted portion of the brush. Here the outer membrane has become thicker, and the large nuclei are those of the ordinary hair-producing cells. Two new structures are now seen to have arisen.

(1) Forming a ring round the central bodies already described are structures whose walls are evidently thin, and present in section an irregular and considerably convoluted appearance. These bodies enclose and thicken the cone in the heart of the brush, dying out to a point a little nearer its distal end. A highly magnified section of one of these is shown on Pl. XVIII, fig. 6. Inside the thin wall is an exceedingly delicate tissue with distinct dots scattered through its substance, and showing a more or less radiate striation. The walls of these bodies do not show signs of the presence of pores.

(2) Outside these " first-ring " bodies we see the ordinary brush-hairs—not, at this level, very well rounded in sec-

tion, but still recognisable as corresponding to the hairs in the *niavius* brush. Pl. XII, fig. 3, is a section a little further towards the distal end. Here the central bodies occupy a reduced area. They are still surrounded by the first-ring bodies, but what may now be called the normal hairs occupy a greater space. It should be particularly noted in this figure that the outer layer of the normal hairs includes relatively many having a flattened section. Pl. XII, fig. 4, is a section still further outwards. The central bodies have almost come to a point, and are surrounded by a fairly thick mass of first-ring structures. The normal hairs, or "second-ring," occupying a large area, are those of the yellow tuft of the brush, corresponding with the yellow hairs of *niavius*. One of these hairs is shown in section at Pl. XVIII, fig. 7. The central lumen is small, the medullary substance presents a more or less radially striate appearance, and the outer surface is longitudinally ribbed.

(3) The black hairs have now begun to arise from the bag membrane. They are of variable diameter, and are separated from the yellow hairs by those of flattened section which occupied the extreme outer layer in fig. 3. We may call these the third-ring bodies. In Pl. XII, fig. 5, the central cone has finally disappeared, the first-ring bodies are coming to a point, whilst the normal hairs, yellow and black, occupy nearly the whole of the area. In Pl. XII, fig. 6 the normal hairs remain, divided, however, by the third-ring bodies, which are larger and flattened towards the end of the brush, and are here seen to be distinctly differentiated. In some species the hairs which thus become terminally flattened eventually break up into small fragments, and thus provide the "dust" which so frequently occurs in connection with these organs.

In *A. egialea* this breaking up does not seem to occur, nor do any of my sections show that dust is produced at all in this species.

The structure of the organs in *A. egialea* differs from that in *A. niavius* in the following manner. The cupped glands of the wing-patch are not continuous, but have rows of blind glands between them. The scales are of a different shape, and do not provide a complete protection for the cups. The gland-cells do not occupy the whole space between the wing-membranes, and those of the blind glands rest on a substructure which presents a horizontally striated appearance. The brush does not consist solely of the yellow and black hairs, but is provided in addition with a core of curiously modified structures of which those occupying the centre are but little chitinised, whilst the yellow and black hairs are separated by a layer of bodies of irregular section extending to the outer end of the brush, where they become much flattened. There is apparently no apparatus for producing dust.

Amauris ochlea, Boisd.

In this species the wing-patch, whilst differing slightly from that of *A. egialea*, resembles it closely in its main features. The scales of the wing-brand are very similar in shape, and in the same way they fail to cover the glands. The cupped glands are in rows which, as in *egialea*, alternate with rows of blind glands. In section the appearance is also similar, but though the gland-cells are of about the same size, the whole wing-patch is somewhat thinner; hence in the cupped glands there is much less space between the cells and the underside of the wing; whilst beneath the cells of the blind glands there is but a trace of the horizontally striated tissue.

The abdominal brushes of *A. ochlea* are also very similar in structure to those of *egialea*. There is a core of central bodies surrounded by first-ring structures, and the black and yellow hairs are separated by a layer of third-ring bodies. These latter, however, are flatter near their origin, after which they become more rounded, and finally again flattened towards their extremities. These bodies, together with the yellow hairs, have, however, a different structure from those of *egialea*. Instead of being regularly striated their surface is studded by immense numbers of what may be termed chitinous nodules, which are very conspicuous both in transverse and longitudinal section, and towards the distal end of the brush undoubtedly become detached, forming a kind of dust which serves the same purpose as the dust produced in various ways by other species. Pl. XVIII, fig. 8, shows a transverse section of one of the hairs, whilst fig. 9 shows the appearance in a longitudinal view. Not only is the outer surface covered with nodules, but similar particles appear to be formed within the hair. It may be noted that these nodules are rather readily stained by haematoxylin. They are not the dried granules of a secretion, since they are unaffected by prolonged immersion in eau-de-javelle, although particles of secretions which I have observed in other species, however fully they may resist the action of the various solvents used in preparing the sections, disappear more or less readily when a drop of eau-de-javelle is placed on the slide. The dust produced in this manner in *A. ochlea* must be very small in amount as compared with that formed in such species as *niavius* and *psyttalea*. I have not reproduced photographs of sections of the brush in *A. ochlea*, nor drawings of the wing-glands, since compared with the same organs in *A. egialea* the differences are so small as scarcely to warrant separate illustration.

Amauris hecate, Butl.

The wing-patch presents alternate rows of cupped and blind glands, as may be seen in Pl. XVIII, fig. 12, showing a section parallel with the nervures. The gland-cells differ considerably from those of *A. egialea*, in that they occupy nearly the whole space between the wing-membranes. The structure may be regarded as somewhat intermediate between that of *niavius* and *egialea*. The scales on the wing-patch, of which one is shown in fig. 10, are also intermediate in shape. They cover the glands very incompletely, though more effectively than those of *egialea*.

The structure of the brush in *A. hecate* is also of an intermediate character. Pl. XIII, fig. 1, shows a section near the base, from which it may be seen that there is a small core of modified scales presenting in large part the characters of both the central and first-ring bodies of *egialea*. These die out rapidly and the greater part of the area of the section is taken up by the yellow hairs, as shown in Pl. XIII, fig. 2, in which will also be noticed, on the side, where the bag membrane is thinnest, a somewhat obscure mass, unfortunately not very clearly in focus. This represents certain flattened hairs which arise on that side and become at higher levels (figs. 3 and 4) somewhat invaginated on one side so as to present a reniform section. These structures may perhaps be regarded as corresponding with the third-ring bodies of *egialea*. In fig. 4 they occupy a large area of the section and are obviously tending to break up, a condition shown still better in fig. 5. They arise from cells in the bag membrane, and in longitudinal section are not at first distinguishable from the yellow hairs. They soon, however, begin to present a nodulated appearance similar to that in *ochlea*, and their disintegration towards the distal end of the brush produces a considerable quantity of dust corresponding with that of other species. It will be noticed from the sections that the black hairs in this species are of comparatively small diameter, and that they arise from an area of the brush-bag which is greatly thickened by the aggregation of small trichogenic cells. Pl. XIII, fig. 6, is a longitudinal section of this area. Pl. XVIII, fig. 13, shows a section of a yellow, and of a black hair, and fig. 11 represents the appearance of one of the flattened and nodulated hairs which ultimately break up to form the dust material. This disintegration occurs through the gradual decrease in the lumen and the thinning down of the bases of the nodules, until the latter become detached. A longitudinal view of one of these hairs presents much the same appearance as that of the corresponding structure in *A. ochlea.*

Amauris whytei, Butl.

The wing-patch in this species is provided with scales which closely resemble those of *A. egialea*, both in shape and in the fact that they do not form a continuous protection for the upper surface of the glands. The structure of the wing-patch differs from all those previously described in not showing any definite differentiation into separate glands. The cup-like structures occur in fairly definite rows, separated by rather wide spaces representing the blind-gland areas described in other species. It will be seen from the section shown on Pl. XIX, fig. 14, that the glandular area is very thin and that the gland-cells are rather irregularly placed between the wing-membranes. Strands of connective tissue joining the two surfaces of the wing presumably exist, although they are but little evident. In this species the wing-patch is either in a more primitive condition or is, so far as thickness and differentiation of structure are concerned, degenerate.

The abdominal brushes are also in some respects different from those already described. Pl. XIV, fig. 1, shows a section of the brush near its base. The brush-bag is seen to be comparatively thick. Large hair-producing cells are present, and in at least two instances the central lumen of these is plainly visible. The first to arise are the small dark-coloured hairs seen near the middle of the section. These form a core continued throughout the length of the brush, and, unlike the components of the core in the *egialea* brush, are heavily chitinised from their origin. Surrounding these are hairs of large diameter, less chitinised, and corresponding with the yellow hairs of other brushes described. The remainder of the section is seen to be occupied by hairs of relatively small diameter and less distinct outline. These at their origin are scarcely distinguishable from the yellow hairs, though they soon become differentiated by their granular appearance. In Pl. XIV, fig. 2, the black hairs have begun to appear at one side and the cuticle of the brush has become thin. Figs. 3 and 4, representing the same structures at higher levels, show an increasing diameter in the hairs of the core. In fig. 5, still higher, the black hairs have become less numerous and those of the core smaller, whilst the granulated hairs now betray their purpose as dust producers, breaking up and forming small nodules as in *A. ochlea.* Fig. 6 is a section taken still nearer the end of the brush. The black hairs have nearly died out, the core hairs are much reduced in diameter, and the dust hairs are continuing to disintegrate. On Pl. XIX, fig. 15, I have endeavoured to show the appearance of one of the yellow hairs as seen under a high power. The outline is very irregular, and the wall seems to be pierced by minute pores occurring here and there, not on the longitudinal ribs, but between them. I am not really certain of the existence of these pores, but careful examination of sections strongly suggests their presence. On Pl. XIX, fig. 16, I have shown one of the granulated hairs as it appears when breaking up. In a section taken near the end of the brush the whole field is strewn with the separated particles.

The principal peculiarities of the scent-organs in *A. whytei* are, then, the thin and simplified wing-patch, and the central pencil of fine stiff hairs in the brush.

So far the organs examined have all been taken from species of one genus, viz. *Amauris*. It will now be profitable to investigate the structure of the scent-apparatus in other Danaine butterflies.

As an example of a small but important genus we may take **Tirumala petiverana,** Doubl.

In this genus the alar scent-organs do not form a patch, but consist of a fold or pocket of the wing. As the brushes are of a less complicated structure than the scent-pocket, it will be convenient to describe them first. They consist of the usual membranous bag from which arise the hairs of the brush, which in this species are all of one form and strongly chitinised. It is unnecessary to give a photograph of more than one section of the brush. Pl. XV, fig. 4, represents the general appearance of any transverse section of that organ, whilst Pl. XIX, fig. 23, shows one of the hairs in section as seen under a high power. I am inclined to think that these hairs are pierced by minute pores. At any rate a very thin section shows a number of pale radial lines between the low ridges which longitudinally traverse the surface. Within the hair-wall is a delicate medullary substance pierced by a longitudinal canal of irregular section, and often of very eccentric position. Pl. XIX, fig. 21, shows a longitudinal surface view of one of these hairs. The structure is very faint, and only visible under a high power, which shows that the fluting or ribbing is not, at least, in the greater part of the hair parallel with the long axis, but takes an undulating course. With regard to the presence of pores in these hairs, it is curious that their existence should be rather strongly suggested in a species in which their utility is least obvious, for the production of a scent-secretion as well as of a dust material appears, as will be seen later, to be amply provided for by the wing-pocket. One other feature remains to be noted. A considerable portion of the interior of the brush-bag, especially towards the open or distal end, is not smooth as in most of the other species examined, but thrown into a great number of minute irregular folds, giving it on a surface view the appearance of being covered by a mass of tiny excrescences. This feature, which is not accompanied by any glandular development, occurs also in *Danaida chrysippus.* So far its significance is obscure.

Pl. XV, fig. 5, is a photograph of a section of the scent-pocket in *T. petiverana.* It consists of an outer chitinous layer bearing large scales, and morphologically part of the underside of the wing. Next to this is a layer of irregular cells, followed by a second layer, from which arise the small dark scales seen in the photograph. Within the cavity of the pocket masses of thread-like bodies may be seen lying loose. Pl. XIX, fig. 19, shows more accurately the structure of the various layers of the pocket. The inner layer exhibits numerous vacuolated cells more or less separated by strands of chitinous material, and associated with scale-sockets from which arise the scent-scales. These are in the form of flattened elongated bags, having a central cavity which almost certainly opens by a pore at the outer end of the scale. Beneath this layer is a second stratum of cells also showing large vacuoles. This layer is highly developed at the closed end of the pocket and becomes greatly attenuated towards the mouth, where it opens on the upper surface of the wing.

It seems convenient here to refer to the notes of Mr. J. C. Kershaw on the structure of the scent-pocket in the very closely allied species *T. limniace*, occurring in the Oriental Region. Mr. Kershaw made, but did not publish, numerous observations on the scent-glands and genital apparatus in certain Oriental Danaines, together with some excellent line drawings. The notes and drawings were handed over to Prof. Poulton at Oxford, and I have his and Mr. Kershaw's kind permission to make use of them. Speaking of *limniace* he says :—

" The interior of the pocket or sac on the underside of the hind-wing (with the opening thereto on the upper side of the wing) is lined with scales entirely different to those overlying the rest of the wing. These scales are bottle-shaped and filled with fluid, but I was unable to detect any special scent. Many of these scales are reduced to powder which lies in the cavity of the sac."

In a subsequent note the same author says :—

" The oily nature of the scent-scales, or rather the oily nature of the liquid contents of the flask-shaped scent-scales, is easily seen when a batch of scales is scraped off and crushed on a slip under a moderate power; or if a single scale is crushed with a needle under a fairly high power, especially if a drop of water is placed on the slip, when the liquid from the scent-scales behaves exactly like oil, floating on the surface in minute globules. The scent-scale liquid is also greasy to the touch, but, of course, a large batch of scales must be crushed to get enough material to test by touch."

The above observations were, of course, made on fresh examples, and my specimens, which had been treated with preservatives and then kept in spirit, do not show the oily contents of the scales. Mr. Kershaw's notes are therefore of the greatest value in enabling us to learn something of the function of the scent-pocket. We may, I think, fairly assume that the vacuolated cells form the glands which produce the oily secretion, and that this is accumulated in the scales and discharged thence into the wing-pocket. There remains then the dust material which occurs in such large masses in the pocket, and can also be observed entangled in the hairs of the anal brush. I was for some time at a loss to discover the true origin of the dust filaments. In my sections of the scent-pocket they were invariably found loose in the cavity and already much broken up. I found the same substance, but in a still more disintegrated condition, amongst the hairs of the abdominal brush. In the brush there was no evidence of dust production, whilst its presence in larger quantities and in a less pulverised condition in the scent-pocket strongly suggested the latter as its place of origin. Probably the truth of the matter would still have remained a mystery, but for my having been fortunate enough to secure, through the kindness of my friend Prof. Poulton, a pupa of *T. limniace*, the oriental form of this species, in which the imago was almost completely formed. The specimen had been sent to the Hope Department from Ceylon by Lieut.-Col. N. Manders. The pupa was not preserved in any way, being merely dried, and I had small hope that sections of any value could be cut from it, but the inspiring optimism of my friend above mentioned was quite justified. A prolonged evaporative embedding in celloidin resulted in my being able to cut sections which revealed the highly interesting fact that the dust filaments are produced beneath the pupal covering, and that, by the time emergence takes place, the cells from which they arose have become practically atrophied. The examination also showed that up to the time of emergence there is *no scent-pocket at all.* The area which subsequently becomes a pocket is, as in the *Amauris* imago, a patch on the hind-wing. In *Tirumala,* however, the expansion of the wing after emergence causes an invagination of the patch, which thus becomes a pocket. In dissecting out the wing from the dried pupa already mentioned I found that the patch was covered with a rather thick mass of material, which in its dry state scaled off and fell to pieces at the least touch. This substance mounted in clove oil proved, as was expected, to be entirely composed of the dust filaments, some of them being of surprising length. They break with such facility, and are so inextricably interwoven, that it was impossible to separate out a single filament. Pl. XV, fig. 6, shows a photograph of a few particles lying at the edge of a mass of the material, whilst Pl. XIX, fig. 22, shows small pieces of the filaments as seen under a high power. Pl. XIX, fig. 20, shows a section of the dried wing before emergence from the pupa. Cell structure is of course absent, as the soft parts have not been preserved, but sufficient remains to show that in the unexpanded wing, the scent-patch, as it then is, contains cells which produce the filaments, forming a mass of dust material, the latter becoming enclosed in the pouch as it is formed by invagination. The little filaments shown in fig. 20 are merely the unbroken basal ends of threads of much greater length. Careful examination of many sections leads me to suppose that the cells which produce these filaments alternate with those which give rise to the scent-scales. The thread-producing cells cannot be recognised in the imaginal wing, and I can only suppose that, having produced the dust material, their function ceases and they become crowded out by the increased development of the vacuolated oil-producing cells.

In *T. petiverana* we have therefore a curious contrast with the structure in *A. niavius*. Instead of the dust material being produced in the brush, it is formed by the wing-patch, although only by that organ in the pupal state.

Danaida chrysippus, Linn.

So much is now known of the bionomics of this abundant species that it is interesting to be able to add something to a knowledge of its structure. The male possesses a small scent-pocket in the hind-wing and the usual pair of abdominal brushes. The scent-pocket is not formed quite like that of *T. petiverana*, since it is really a projection from the wing surface subsequently folded over to form a kind of recess. Thanks to my friend Lieut.-Col. Manders, I have been able to make preparations from the pupa of this species, sent to me in a properly preserved condition, so that something of the final development of the scent-organs has been disclosed.

The brush contains hairs of one kind only and of simple structure. Both transverse and longitudinal sections show that there are, entangled in the hairs, large numbers of minute spherules—apparently a coagulated secretion. They are certainly not chitinous particles of dust material, since they dissolve fairly readily and not slowly in eau-de-javelle. From the appearance of these granules in a longitudinal section, one is tempted to believe that they are extruded from the hairs themselves, since they adhere thereto very closely in many places. The absence, however, of any glandular structure in the cells of the brush-bag lends greater support to the theory that they are in fact a product of the secretion produced in the wing-pocket. The brush-hairs are round in section for part of their length, but become much flattened towards their distal extremities. Pl. XIX, fig. 26, shows a section of one of these hairs; fig. 27 a longitudinal surface view. The surface of the hair is seen to be traversed by longitudinal curved ridges, each of which bears two rows of small projections arranged alternately on each side of the crest. As in *T. petiverana* there is no pocket in the unexpanded wing, but the portion which afterwards becomes invaginated consists of a diverticulum. Pl. XVI, fig. 1, is a photograph of a section of a wing before emergence. On the right may be seen the outgrowth from the wing-surface covered on its outer side by a layer of small thick scales. The double row of delicate structures in the centre of the section represents the ordinary scales of the upper surface of the wing. Pl. XX, fig. 28, is a drawing of a small portion of that part of the unexpanded wing which will form the scent-pocket in the imago. The cells which produce scales are highly vacuolated, and alternate with cells attached to cup-like projections somewhat similar to those already described in other species. The cup-cells at this stage seem mainly to produce those long processes described by Mayer,* which ultimately form the fibres holding together the upper and lower surfaces of the wing during expansion. Nevertheless some of them ultimately develop into cells which appear to differ but little from those attached to the scale-sockets. The cause of the folding in of the diverticulum during expansion may be easily discerned by comparison with Pl. XIX, fig. 25, which shows in section a part of the ordinary unexpanded wing-membrane. Here the chitin is thrown into deep folds which will become flattened during expansion. The patch is already flat, and being incapable of extension, becomes covered by a fold. Pl. XIX, fig. 24, shows a cup and a socket-cell from the imaginal wing. These cells are highly vacuolated, finely granular, and occasionally provided with more than one nucleus, especially the socket-cells. Mayer (*loc. cit.*) describes the nuclei of the scale-producing cells in the wing of *D. plexippus* as occasionally undergoing amitotic division, so that we may suppose this process also to take place in the present species (a broken scale is shown arising from the right-hand cell). The "cups" have no relic of a scale-stalk as in *D. lotis*, but appear to possess a central pore, though this is scarcely so obvious as in some species of *Amauris*. The scales lining the pocket have an appearance which suggests that they are traversed by pores, though the structure is less easily discernible than in *lotis*. There is no evidence in either pocket or brush of the production of any dust material.

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* Bull. Harvard Mus., vol. xxix, p. 209 *et seq.*, 1896.

A longitudinal section of the brush within the pupa shows the hairs arising from highly vacuolated cells, each with a large nucleus. The cytoplasm is finely granular, and stains less readily towards the extremity from which the hair arises.

Danaida lotis, Cram.

In this species there is a fold in the hind-wing resembling that of *D. chrysippus*, and a pair of abdominal brushes, the latter presenting no special features. The hairs are of one kind and strongly chitinised. In general their sections resemble those of *chrysippus*, and small spherical particles of a dried secretion may be observed entangled amongst them. Some hairs are flattened for a portion of their length or depart in other ways from the more truly circular section usually exhibited. Their functions are probably merely mechanical. Pl. XVI, fig. 2, is a photograph of a section of the brush not far from the distal end. Pl. XVI, fig. 3, shows a photograph of a transverse section of the wing-pocket, which is seen to be a more or less spiral fold of the wing. The pocket contains no dust material, and as none is found in the brush it is evidently not produced in this species. A surface view of the membrane with which the pocket is lined shows that alternate scale-sockets are modified into structures resembling scent-cups, whilst the remaining sockets present a more or less normal appearance. A section through a portion of the pocket is shown at Pl. XX, fig. 29. The cupped glands contain a comparatively small cell, finely granular and possessing a large nucleus. From each arises a delicate projection which is doubtless a degenerate scale. From each unmodified socket arises a scale, and they are sufficiently numerous to form a complete lining to the pocket. These scales are porous, the minute openings lying along the striations of the surface mainly in the central area of the upper side. In connection with each scale is a large cell, the upper part of which is densely packed with large and conspicuous granules having a deep brown colour in unstained examples. These coarse granules usually obscure the nucleus which is also present in the upper half of the cell. They do not dissolve in ether, alcohol, or xylol, and are only very slowly affected by eau-de-javelle. The remainder of the cell is occupied by a delicate and highly vacuolated reticulum, presenting a finely granulated structure. Whether the hair-like vestigial scales arising from the cupped cells are open tubes or not I have been unable to decide. The covers of the cups have, however, rather the appearance of being minutely perforated, though this point is also extremely difficult to decide.

It should be noted that the structure described above, in so far as it consists of special scales alternating with delicate stalks, is similar to that described by Müller as occurring in *D. erippus*.*

Parantica eryx, Fab.

This species bears on the hind-wing a scent-patch of considerable size and presenting a somewhat pear-shaped outline. In surface view it shows regular rows of scent-cups alternating with normal scale-sockets from which arise scales much resembling those of *Amauris niavius* in shape, though rather larger. They form a continuous covering for the scent-patch of which a section is shown at Pl. XIX, fig. 17. Perhaps the most striking features of the patch are its comparative thinness and the large number of nuclei observed in each gland. In some cases I have counted as many as seven. Whether this number indicates the presence of seven cells, or whether some cells have more than one nucleus, has not been determined. There are no intermediate or blind glands. The portion of the patch from which the drawing is made represents its maximum thickness. A considerable area is not any thicker than the rest of the wing, the upper and lower membranes being in close juxtaposition, and the glands so reduced as to occupy merely the interior of the scent-cup projecting from the upper-wing surface. The brush is of simple structure containing but one kind of hair. Pl. XV, fig. 1, is a reproduction from a photograph of a section of the brush near the base of the bag, showing that the sections of the outer hairs are not circular but irregular in outline. Fig. 2 represents a section taken at about the middle of the brush, and fig. 3 one near the end. In the latter it will be observed that the hairs have rather obscured outlines, due to the fact that they produce a certain amount of dust material by the breaking off from their surface of small projections. Pl. XIX, fig. 18, shows a longitudinal view of a portion of one of the hairs bearing small leaf-like projections which readily break off, and thus form detached particles. The dust produced is of very small volume.

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* See my previous paper, Trans. Ent. Soc. Lond., p. 403, 1913.

Trepsichrois mulciber, Hubn.*

The scent-organs in this species consists of a pair of abdominal brushes and perhaps a large patch of special scales near the costa of the hind-wing, though in the case of the latter there is some reason to suppose that, if it has to do with the scent-apparatus at all, the function is mechanical. As compared with the brushes in the species already described, those of *T. mulciber* differ in their distinct connection with the actual seat of production of the scent. The brush-bag differs from that of the only other related species which I have been able to examine, in being provided with a peculiar accessory vessel at its base, though I would at once state that I have unfortunately had only a single example from which to make preparations, and the possibility, however remote, must be borne in mind that this structure may have been an abnormality. When dissecting out the brushes this accessory vessel became visible to the eye and appeared as a small vesicle attached to the proximal end. Pl. XVI, fig. 4, represents a photograph of a longitudinal section passing through the vesicle; fig. 5 a transverse section at the point where the vesicle opens into the base of the brush-bag proper, in which latter a few of the hairs can be seen cut across. Fig. 4 shows that the vesicle consists of an outer layer of cells with conspicuous nuclei. From these cells arise narrow funnel-like structures somewhat chitinised and homologous with hair-sockets. From these, again, spring very delicate tubes of irregular section which more or less fill the cavity. Pl. XX, fig. 31, shows one of these funnel-sockets arising from the deep layer of vacuolated cells, the latter being partly seen in section. The delicate tube arising from the socket bulges out and overhangs the latter. The socket shows a core of cytoplasm which, judging from stained preparations, appears to divide at the distal end. The whole structure strongly suggests that some secretion is discharged from the funnel-sockets into the vesicle, through the delicate tubes, and passes thence into the cavity of the brush-bag proper. Pl. XVI, fig. 6, represents a photograph of a longitudinal, and Pl. XVII, fig. 2, a transverse, section of the brush-bag. The latter is distinctly glandular, many more cells being present than are found in species of *Amauris*. The hair-sockets are long and more or less funnel-shaped as in the vesicle, though somewhat less constricted at the middle of their length. Pl. XX, fig. 30, shows one of the hair-sockets under a higher power. Several cells are seen to form a basal gland in connection with a single hair, and at one side appears the lumen of a trachea, many of which are found in intimate connection with the brush-bag in this species. Pl. XX, fig. 32, shows a transverse section of one of the brush-hairs at a point towards its extremity, whilst fig. 33 represents the appearance of a longitudinal view of the same portion of the same hair. Near their origin and for a considerable portion of their length these hairs are either comparatively smooth or only faintly striated, but towards the distal extremity they develop more of less regular lines of projections. I have been unable actually to see pores in these hairs, but that there are openings to the exterior seems a reasonable conclusion from the glandular nature of the brush-bag. One other point should be noticed. The wall of the bag is glandular and gives rise to hairs along nearly its whole length, so that the appearance on eversion must be that of a test-tube-brush instead of a spherical tuft as in *Amauris*. I have found no evidence of any dust-apparatus in this species.

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* Better known as *Euploea midamus.*

We have now to consider the special area on the hind-wing. On the upper side, extending over a large portion of the discoidal cell, and from the third median to the subcostal is an area covered by long scales which give it a furry appearance. One of these scales is shown at Pl. XX, fig. 34*a*. It consists of a long narrow section culminating distally in a spatulate formation which bears numerous small hair-like projections. In the discoidal cell of the hind-wing there is in addition a somewhat quadrate patch of greyish brown scales, which also differ from those covering the rest of the surface. One of these scales, also shown at Pl. XX, fig. 34*b*, is seen to be broad, with a length of about three times the width, and apparently somewhat thickened in the central area.

The function of these specialised scales is obscure. They are supposed to be, and possibly are, scent-scales, though sections through the wing at points where they occur do not show any special cells, or indeed any cells at all, in connection therewith. If the insect can by any means transfer scent material from its brushes to the fur patch, the latter might serve as a distributing apparatus, but we require greater knowledge of the living butterfly in its natural surroundings before the function of these patches can be established. Kershaw mentions the species in the notes above referred to, and of the use of the brushes he speaks as follows :—

"Whilst flying up and down some shady pathway the butterfly often everts and retracts the glands, sometimes partially and sometimes fully : both when solitary and when in company with others of its kind. I could never be quite certain that the glands emitted any scent, though doubtless they do so. A powerful odour which would attract the attention of an insect might, I suppose, be imperceptible to human olfactory organs. In any case, the bright golden hairs of the glands are plainly discernible many yards away as the insect is constantly thrusting the glands out and withdrawing them."

The only other Euploeine butterfly I have examined is **Tronga brookei,** Moore. This species has no brands or patches of special scales on the wing, and the brushes must therefore perform their scent-producing functions unaided. I have not thought it necessary to photograph any of the sections, as they could scarcely be distinguished from those of *T. mulciber*. The brush-bag possesses the same glandular structure, though the hairs are far more irregular in transverse section. Whether owing to actual divergence in structure or to some difference in the condition of the specimen or method of preparation, the hairs in longitudinal view seem to show their structure more distinctly than in *T. mulciber.* Over a large part of their length they are covered with projections, the form of which I have endeavoured to show in Pl. XX, fig. 35. There is no dust-apparatus and no accessory vesicle attached to the brush-bag.

Hestia lynceus, Drury.

The species of the genus *Hestia* do not possess either scent-patch or pocket on the wings. They are, however, remarkable in having four abdominal brushes instead of two. Whilst the purpose of this modification is obscure, its origin is at least suggested by the condition of the brushes in such a species as *Amauris niavius*, where a separate tuft of stiff black hairs arises from a limited area of the brush-bag. The auxiliary brush in *Hestia* seems to represent a modification of this special tuft lying in a separate bag. It lies parallel with the main brush and rather above it. It is much shorter and more slender, the basal end being less deeply placed in the abdomen. It is of simple structure, contains but one kind of hair, and the containing bag appears to have a slightly glandular structure confined to one side. Pl. XVII, fig. 2, shows a section of one of these brushes beyond the glandular level of the bag. Near their origin the hairs are occasionally invaginated along one side, giving the section a reniform appearance. Under a high power the hairs present a close resemblance to those of the larger brush in the same species. Pl. XVII, fig. 3, shows a section of the large brush, close to the basal end. It will be observed that the brush bag is formed of a mass of small cells, differing entirely in appearance from those found in the same situation in species of *Amauris,* but resembling the glandular cells in the brush-bag of *T. mulciber.* Pl. XVII, fig. 4, is a section taken rather further from the base, and shows much the same structure, which continues for some distance (fig. 5). Finally, the glandular structure disappears and the bag towards its mouth becomes a mere membrane (fig. 6).

The hairs of which the brush is composed, though well rounded at their origin, become somewhat flattened and of irregular section towards their distal extremities. Some hairs contain particles of a brown secretion, which appears in the photographs as a blackening of the section. Pl. XX, fig. 38, is a section of one of the hairs at about the middle of its length, showing the contained granules, whilst fig. 39 taken nearer the distal end is without these. Fig. 37 is a surface view of one of the hairs somewhat beyond the middle of its length. The hair is covered with projections having a curious form, their outer surfaces bearing delicate ridges and their extremities produced to fine points. Pl. XX, fig. 36, shows the appearance of the glandular cells of the main brush-bag. It is scarcely possible to decide how many cells belong to each hair-socket. Possibly the number may vary. I have here shown three, since in the preparation from which the drawing was made three cells could be recognised with some certainty as attached to this particular socket. Beneath the entrance of the hair is a rod of protoplasm usually staining rather darker than the rest, and surrounded by vacuoles. The cells are very finely granulated and contain large and conspicuous nuclei. There is no dust material in *Hestia lynceus*. The absence of wing-glands and the glandular structure of the brush indicate that the scent-material is produced by the latter, being apparently secreted by the cells and discharged into the interior of the hairs. Thence it must make its way to the exterior, and doubtless openings exist, although I have not been able to discern them. It is possible that the passages, which must be very minute, may be hidden by the projections on the hairs.

Summary.

In the foregoing pages I have endeavoured to describe as concisely as possible the actual structure of the remarkable organs associated with the production of scents in a few species of tropical butterflies. It may be objected that in no case is there any direct evidence that a scent is produced at all. Such evidence cannot, however, be expected from examples which, for histological purposes, have been subjected to the chemical action of preservatives. It is furthermore to be admitted that Mr. Kershaw working in the field could detect no actual scent in *T. mulciber*. Nevertheless, we know from the observations of Fritz Müller, Dixey, Longstaff, and others that very many Lepidoptera do produce scents perceptible to the human olfactory organs, and further that such odours can be definitely associated with wing-brands, tufts, scales, and other specialised portions of the anatomy of these insects. In the case of the Danaine brushes and brands we can have no doubt as to the function, or the association of that function with sexual purposes. Throughout the animal kingdom we are familiar with an infinite variety of elaborate devices providing for the continuance of the species, and in insects the olfactory sense seems pre-eminently chosen as the agent whereby the species may attract and find its mate. Perhaps the most remarkable feature of the organs here described is the elaborate development of friable hairs producing quantities of dust which almost certainly plays a very important part in the distribution of the scent, an interpretation strongly supported by the observed behaviour of *A. psyttalea*, and it is further remarkable that the dust may arise from either the brush or the wing according to the species. As I pointed out in my previous paper the dust material is no new discovery. The late Dr. Fritz Müller, whom little seems to have escaped, described such hairs in the wing-folds of Hesperidae and called them "chain-bristles," since they took the form of long hairs constricted at regular intervals and liable to break at each constriction. My friend Mr. A. H. Hamm has lately called my attention to large masses of yellow "fluff" occurring on the hind-wing of the male moth *Erebus macrops*. I find this to consist mainly of "chain-bristles" of an exceedingly beautiful form.

The studies described in the present paper show how a modest equipment of technique applied to suitable material may disclose much that is interesting in the mere structure of the organs in question, but of their physiology we know little or nothing. If the simple brush of *D. chrysippus* can perform its function efficiently what is the significance of the five different structures found in the complicated brush of *A. egialea*? The granules in the wing-cells of *D. lotis* are not of the same chemical nature as the secretion granules subsequently deposited in the brush. In what does the change consist? Do some of these brushes secrete a substance which combines with another stable compound provided by the wing patch to form a volatile oil? In *A. niavius* the wing-glands are neatly covered by a layer of scales which seem precisely adapted for the purpose of protection. Hence we might suppose that the secretion of the wing is easily evaporated and must be protected, yet in *A. egialea* the scales cover the glands so imperfectly as to be probably useless for such a purpose.

It is to be feared that the study of the chemistry of these secretions is only possible in those countries where the insects may be obtained in large numbers and in fresh condition. Meanwhile I would proffer one or two suggestions to those collectors abroad who may take an interest in the subject. In detecting delicate odours and locating their origin it would seem that some success might be attained by using a glass tube one end of which would fit the human nostril the other being drawn out to a comparatively narrow diameter. The narrower end being applied to suspected centres of emission the odour might reach the human olfactory epithelium in a less diluted form than it necessarily does under ordinary circumstances. Furthermore, a number of crushed wing-brands might be placed in a small phial and warmed so that the scent might become sufficiently concentrated to be perceptible. Again, assuming a plentiful supply of material, might it not be possible to apply the principles of perfume manufacture to the extraction of any scent that may be present in certain organs? Large numbers of the scent-brands of some common species could be crushed and mascerated with a very small quantity of clarified lard and the product distilled with alcohol.* Or by means of a tube with a tightly fitting screw, and a minute aperture at one end, an appreciable quantity of the scent material might be expressed from a mass of the brands.

Finally, whilst fully recognising the excellent contributions already made to our knowledge of the subject by the authors mentioned in the course of this paper, it would seem that there still remain opportunities for comprehensive researches covering an interesting field, which it is to be hoped will attract the attention of our many capable workers in the tropics.

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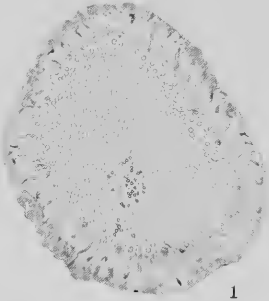
* Dr. Dixey has already shown that in the case of certain Pierines there may be made from the wings an alcoholic extract possessing the characteristic odour of the species from which it was prepared. See Proc. Ent. Soc. Lond., p. lix, 1905.

EXPLANATION OF PLATES XI–XX.

[*See Explanations facing the* PLATES.]

JUNE 26, 1915.



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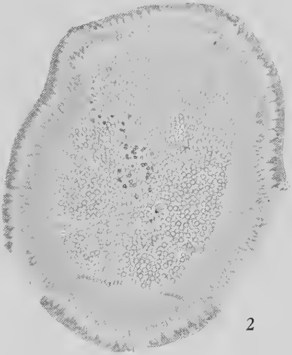

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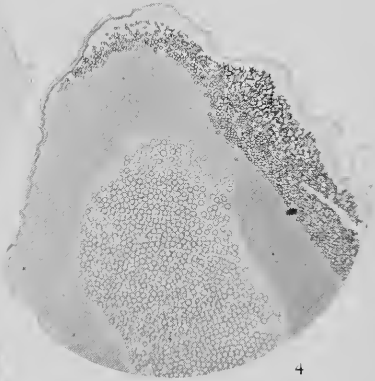

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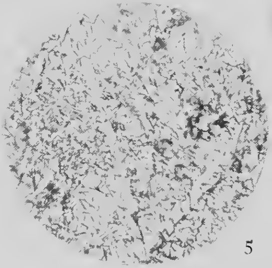

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H. Eltringham, Photo.

Andre, Sleigh & Anglo, Ltd.

AMAURIS PSYTTALEA, BRUSH, &c.

Explanation of Plate XI.

Fig. 1.	*Amauris psyttalea.*	Section of brush near base of same showing "yellow" hairs, thick cuticle and a few fine stiff hairs in centre.
2.	,, ,,	Section at origin of dust hairs showing modification of cuticle where these arise.
3.	,, ,,	More distal section, showing black hairs arising, and "yellow" hairs surrounded by dense mass of dust hairs.
4.	,, ,,	Portion of a section still nearer distal end. Black hairs are now more numerous.
5.	,, ,,	Small area of a slide showing dust produced by breaking up of dust hairs.

(All × 50.)

EXPLANATION OF PLATE XII.

FIG. 1. *Amauris egialea.* Section of brush near base showing central bodies.

2. ,, ,, More distal section. Central bodies are now surrounded by "first ring" structures, and these again by the "yellow" hairs.

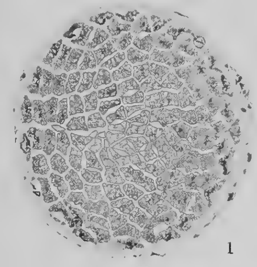
3. ,, ,, Ditto. Outside the "yellow" hairs, structures of irregular section can now be seen.

4. ,, ,, Ditto. The central bodies have almost disappeared. The black hairs are now arising separated from the "yellow" hairs by those of irregular section seen in section 3.

5. ,, ,, Ditto. The "first ring" structures are now disappearing.

6 ,, ,, Ditto. The black and yellow hairs remain, separated, however, by the irregular structures already referred to.

(All × 50.)



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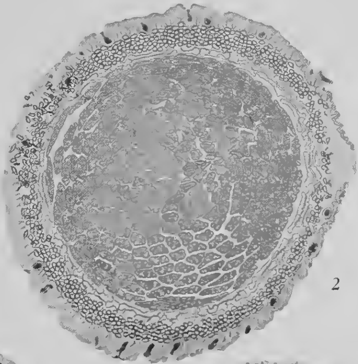

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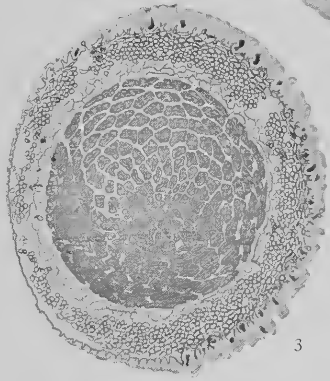

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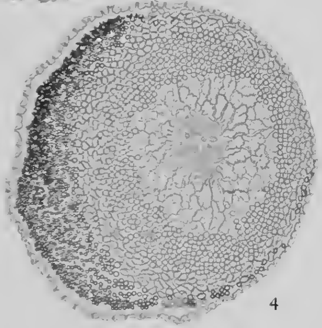

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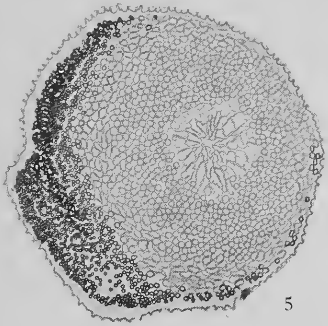

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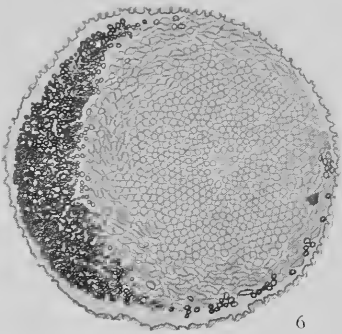

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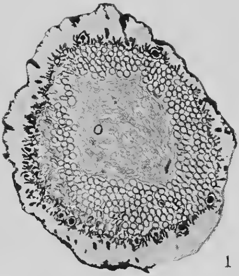
H Eltringham, Photo.

Andre, Sleigh & Anglo, Ltd

AMAURIS EGIALEA, BRUSH.

Trans. Ent. Soc. Lond., 1915, Pl. XIII.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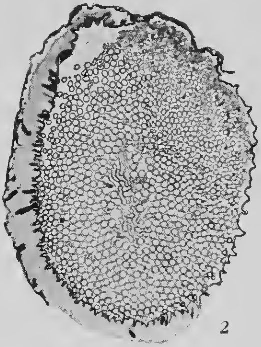
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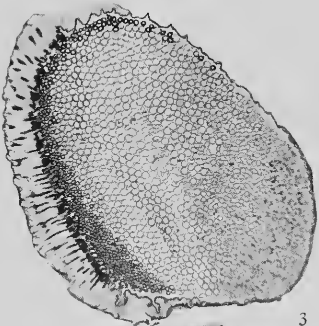
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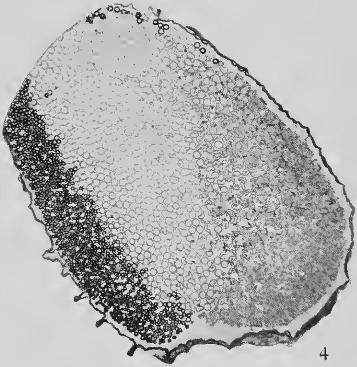
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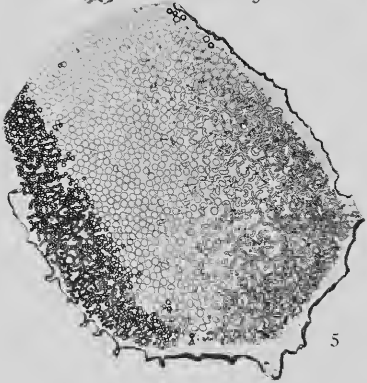
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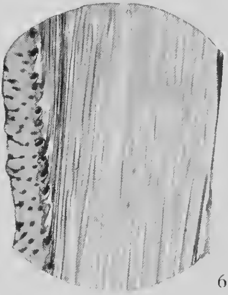
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H. Eltringham, Photo.

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AMAURIS HECATE, BRUSH.

EXPLANATION OF PLATE XIII.

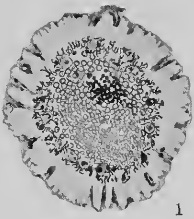
FIG. 1.	*Amauris hecate.*	Section of brush near base. Central bodies, surrounded by "yellow" hairs, are seen.
2.	,, ,,	More distal section. Central bodies have almost disappeared. At upper right side are seen rather indistinct structures. These are the hairs which ultimately form the dust.
3, 4, 5.	,, ,,	Further sections showing the arising of the black hairs and the development of the dust hairs, many of which, in figs. 4 and 5, show a reniform section.
6.	,, ,,	Longitudinal section of cuticle of brush bag at origin of black hairs.

(All × 50.)

EXPLANATION OF PLATE XIV.

FIG. 1. *Amauris whytei.*	Section of brush near base. Note central core of stiff fine hairs.
2. ,, ,,	More distal section. Central core continued, and black hairs arising.
3–6. ,, ,,	Further sections showing gradual development of the granulated or dust-producing hairs.

(All × 50.)



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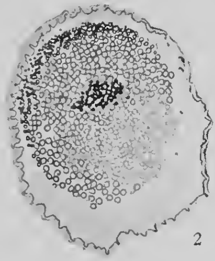

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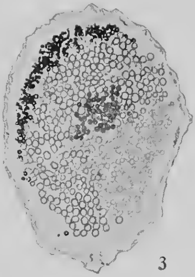

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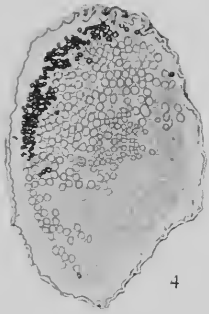

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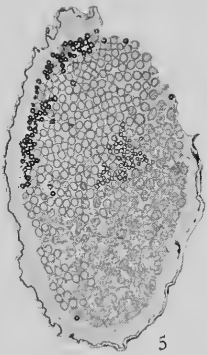

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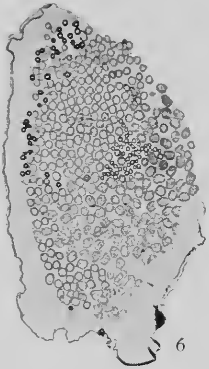

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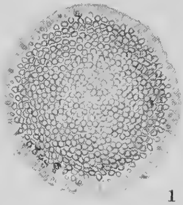
AMAURIS WHYTEI, BRUSH.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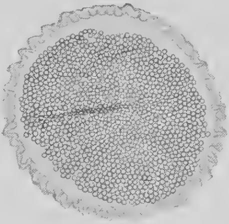
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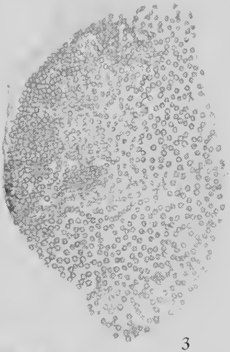
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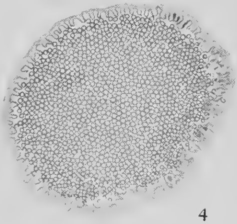
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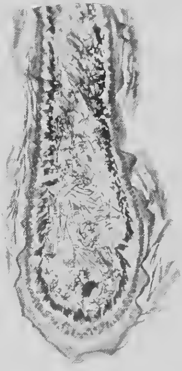
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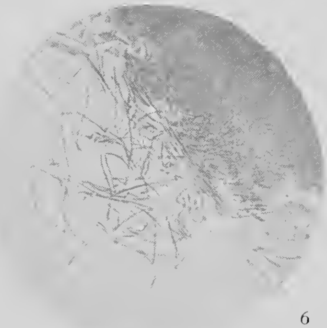
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P. ERYX AND T. PETIVERANA, BRUSHES, &c.

Explanation of Plate XV.

Fig. 1–3.	*Parantica eryx.*	Sections of brush. In this species the brush contains but one kind of hair. (× 50.)
4.	*Tirumala petiverana.*	Section of brush. There are no complications in this species, and any section shows much the same appearance. (× 50.)
5.	,, ,,	Section of scent pocket of wing showing contained dust material. (× 75.)
6.	,, ,,	Dust material from wing pocket. (× 75.)

Explanation of Plate XVI.

Fig. 1. *Danaida chrysippus.* Section of wing before emergence from pupa. On the right is the diverticulum which, when invaginated after emergence, forms the scent pocket. (× 75.)

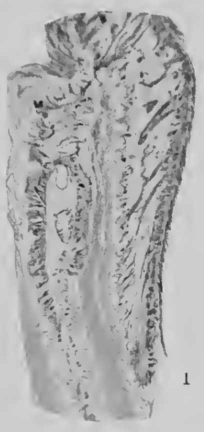
2. ,, *lotis.* Section of brush near distal end. The dark spots here and there are particles of a dried secretion. (× 50.)

3. ,, ,, Section of wing pocket showing its spiral formation and deep glandular cells. (× 50.)

4. *Trepsichrois mulciber.* Longitudinal section through accessory vesicle of brush bag. Note epithelium with many nuclei and funnel-like sockets from which arise delicate membranous tubes. (× 50.)

5. ,, ,, Transverse section at base of brush bag. At lower right-hand side is seen passage from same to accessory vesicle. (× 50.)

6. ,, ,, Longitudinal section at base of brush bag showing glandular cells and funnel-shaped sockets of hairs. (× 50.)



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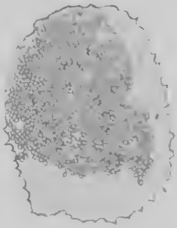

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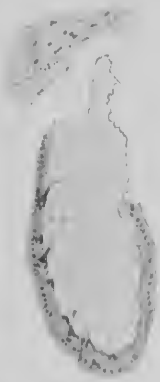

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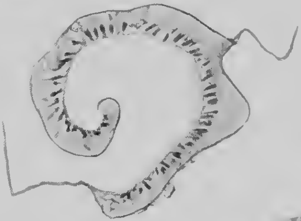

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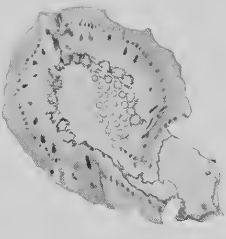

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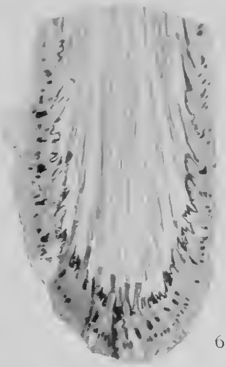

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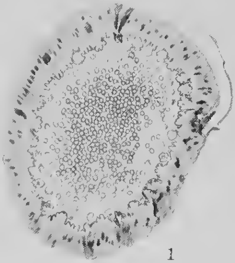
DANAINE SCENT-ORGANS.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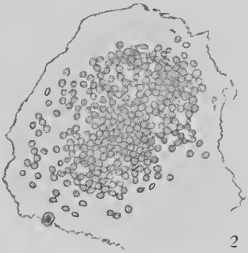
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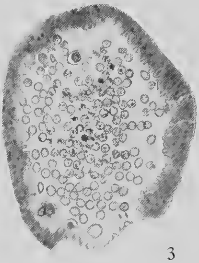
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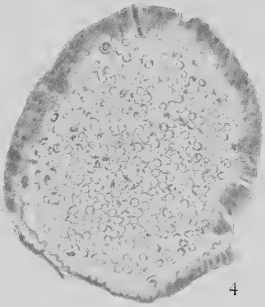
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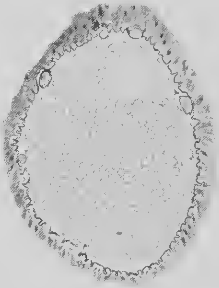
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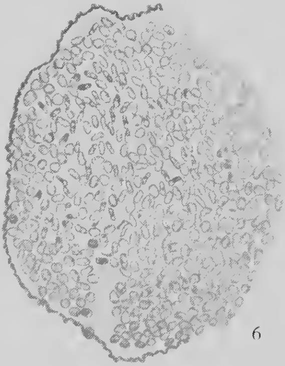
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DANAINE SCENT-BRUSHES.

EXPLANATION OF PLATE XVII.

FIG. 1. *Trepsichrois mulciber*. Transverse section of brush bag, corresponding to the longitudinal section shown at Pl. XVI. fig. 6.

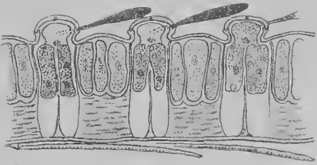
2. *Hestia lyncaeus*. Section of small brush.

3–5. ,, ,, Sections of large brush showing glandular nature of brush bag (3–5) and appearance of hairs which arise therein.

(All × 50.)

EXPLANATION OF PLATE XVIII.

FIG. 1. *Amauris egialea.* Section of wing patch parallel with direction of nervures. (× 175.)
2. ,, ,, Ditto transversely to same. (× 175.)
3. ,, ,, Comparative appearance of ordinary scales of wing and those in scent patch. (× 212.)
4. ,, ,, Semidiagrammatic surface view of part of wing patch showing "cupped" and blind glands and position of scales. (× 250.)
5. ,, ,, Transverse section of one of central bodies of brush. (× 400.)
6. ,, ,, Ditto of one of the "first ring" bodies. (× 400.)
7. ,, ,, Ditto of one of the "yellow hairs." (× 600.)
8. ,, *ochlea.* Transverse section of one of the "third ring" bodies showing nodules. (× 700.)
9. ,, ,, Longitudinal surface view of same. (× 600.)
10. ,, *hecate.* One of the scales of wing patch. (× 230.)
11. ,, ,, Transverse section of a dust hair. (× 700.)
12. ,, ,, Section of wing patch parallel with nervures. (× 160.)
13. ,, ,, Transverse section of a "yellow" and a black hair from brush. (× 700.)



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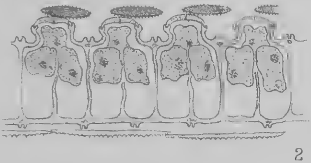

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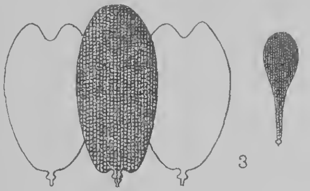

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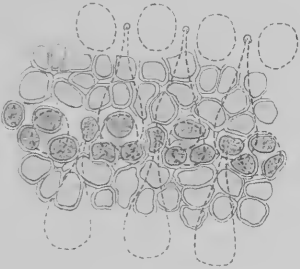

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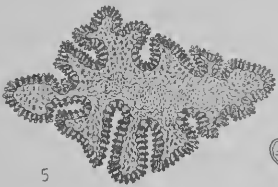

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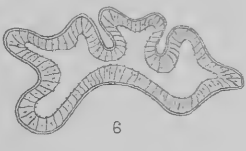

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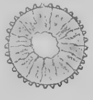

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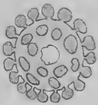

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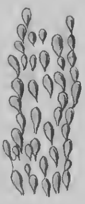

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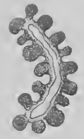

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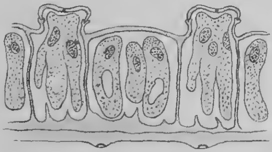

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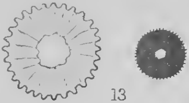

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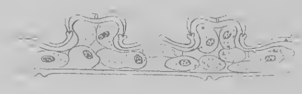
H. Eltringham del.

West, Newman lith.

DANAINE SCENT-ORGANS.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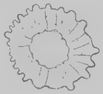
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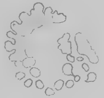
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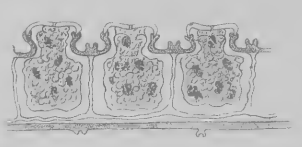
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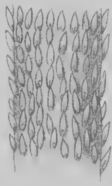
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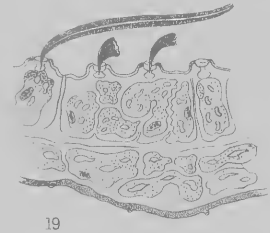
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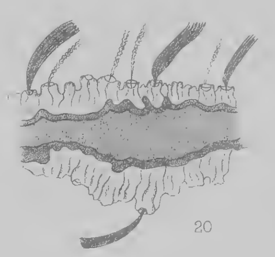
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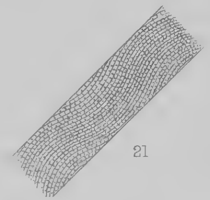
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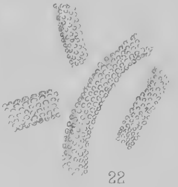
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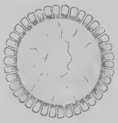
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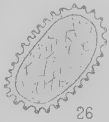
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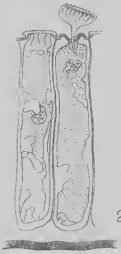
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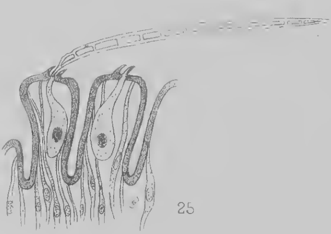
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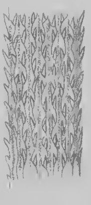
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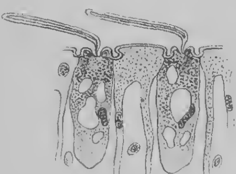
DANAINE SCENT-ORGANS

Explanation of Plate XIX.

Fig. 14. *Amauris whytei.* Section of wing patch. (× 200.)
15. ,, ,, Transverse section of one of the "yellow" hairs. (× 350.)
16. ,, ,, Ditto of one of the granulated hairs breaking up to form dust. (× 350.)
17. *Parantica eryx.* Section of wing patch. (× 250.)
18. ,, ,, Longitudinal surface view of part of one of the brush hairs. (× 700.)
19. *Tirumala petiverana.* Section of part of wing pocket showing scent scales and double layer of cells. (× 150.)
20. ,, *limniace.* Section of alar scent organ, made from a dried pupa, showing remains of filaments which form the dust. (× 75.)
21. ,, *petiverana.* Longitudinal surface view of part of a brush hair. (× 450.)
22. ,, *limniace.* Fragments of the dust filaments. (× 750.)
23. ,, *petiverana.* Transverse section of a brush hair. (× 850.)
24. *Danaida chrysippus.* Two cells from lining of alar scent pocket. (× 120.)
25. ,, ,, Section of unexpanded wing showing folds of chitin, scale-forming cells, etc. (× 120.)
26. ,, ,, Section of brush hair. (× 850.)
27. ,, ,, Longitudinal surface view of part of same. (× 850.)

Explanation of Plate XX.

Fig. 28.	*Danaida chrysippus.*	Section of part of unexpanded wing taken through area which will form scent pocket in the imago. (× 500.)
29.	,, *lotis.*	Section of part of alar scent pocket showing scent scales with large cells alternating with small cells and rudimentary scales. (× 150.)
30.	*Trepsichrois mulciber.*	Section of hair socket from brush bag showing gland cells associated with hair. (× 125.)
31.	,, ,,	Epithelium, funnel socket, and part of membranous tube from accessory vesicle. (× 125.)
32.	,, ,,	Transverse section of a brush hair. (× 750.)
33.	,, ,,	Longitudinal surface view of part of same. (× 750.)
34*a*.	,, ,,	Scale from fur patch of hind-wing. (× 75.)
34*b*.	,, ,,	Scale from discoidal cell patch of ditto. (× 75.)
35.	,, *brookei.*	Part of a brush hair showing projections. (× 500.)
36.	*Hestia lynceus.*	Gland cells of one of the hairs of large brush. (× 125.)
37.	,, ,,	Surface view of part of a hair from large brush. (× 500.)
38.	,, ,,	Section of a hair near middle of its length. (× 500.)
39.	,, ,,	Ditto near distal end. (× 500.)



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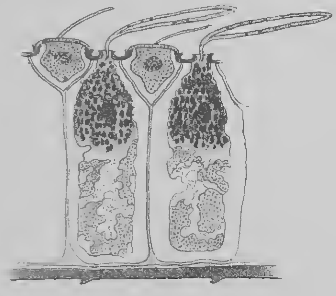

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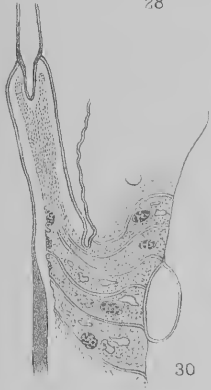

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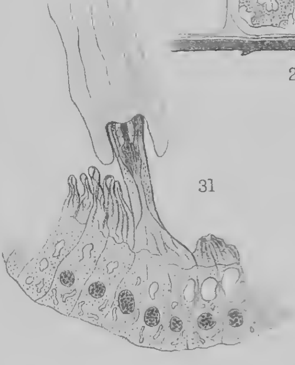

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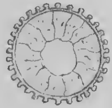

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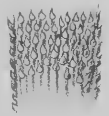

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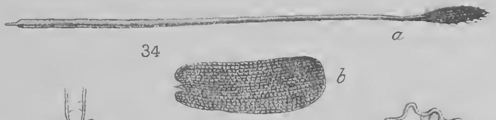

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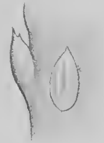

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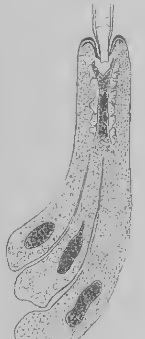

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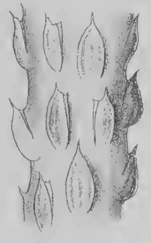

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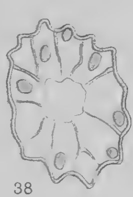

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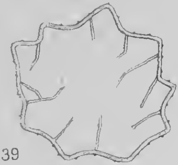

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H. Eltringham del.

West, Newman lith.

DANAINE SCENT-ORGANS

IX. *The Scent-scale of* Pinacopteryx liliana *Gr. Smith.*

By F. A. Dixey, M.A., M.D., F.R.S., Subwarden of Wadham College, Oxford.

[Read June 4th, 1919.]

Plate XVI.

In a recent communication on the *charina* group of *Pinacopteryx*,[*] mention was made of the remarkable scent-scale of *P. liliana* Gr. Smith, ♂. It is now proposed to give a fuller account of this structure, so far as its details can be made out in the absence of fresh material.

As has been elsewhere recorded,[†] the outline of the lamina of this scale, when seen on the flat, resembles that of the thin glass flasks used in chemical laboratories (Pl. XVI, fig. 1). At the junction of the neck with the body of the flask there is a round or oval granular area (*a*), which under moderate powers of the microscope appears dark by transmitted light, and usually shows a comparatively transparent, highly refracting, roughly circular patch in the middle. The proximal part of the lamina is marked by a fine longitudinal ribbing, which loses distinctness as the central granular area is reached. Examined with a $\frac{1}{12}$-inch immersion lens, each rib in the proximal dilated portion of the lamina has a varicose appearance, as if consisting of a row of very fine granules; these rows can be traced with some difficulty through the central area. Beyond the central area, and throughout the distal portion or neck of the lamina, the ribs are still visible, now parallel with each other and closer together; in this situation the ribs are finer and the varicose appearance is less marked. In the region of the central area, numerous additional granules come into view; these are somewhat larger than the rib-granules and are irregularly disposed. Their presence tends to obscure the regular ribbing of the scale; this, however, probably persists throughout the central area, being continuous in fact from base to apex of the lamina. If the scale be stained with a solution of coal-tar "light green" in alcohol and examined dry, the varicose ribs are shown with greater distinctness, and the central area is seen to contain a homogeneous body staining deeply with the reagent; this body, hereinafter referred to as the "central substance," corresponds with the highly-refracting patch visible in the unstained scale. The granules of the central area appear to be unstained; but the presence of the granules, and especially the deep coloration of the central substance, interferes with the tracing of the ribs in their course through the central area. If the stained scale be mounted in Canada balsam, it becomes so transparent that over the greater part of the lamina the ribbing can only be made out with difficulty. The central substance, however, is very clearly defined; and in its neighbourhood the ribbing and granules are fairly distinct.

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[*] Trans. Ent. Soc. Lond., 1918, p. 191.

[†] Proc. Ent. Soc. Lond., 1912, p. cx, Pl. E, fig. 10.

Further light upon the relation of the central substance to the general structure of the scale is afforded by some sections prepared with great skill by my friend Dr. H. Eltringham. Sections taken longitudinally through the fore-wing in a male specimen of *P. liliana*, stained with light green and safranin and mounted in Canada balsam, show the wing-membrane stained a deep pink, with sockets on both upper and lower surface for the reception of the footstalks of the scales (Pl. XVI, fig. 2). Sockets of the ordinary character occur on both surfaces; but on the upper surface, in addition to these, there are visible the special sockets for the reception of the basal portion of the scent-scales; further reference to these special sockets and the articulating structure of the scale will be made later.* Many of the scent-scales are shown in section; sometimes the whole length of the scale is visible, from the portion engaged in the socket to the tuft of fimbriae at the distal extremity (Pl. XVI, fig. 3). In these cases the scale itself exhibits a pink staining, generally paler than that of the wing-membrane; while the central substance (*c*) is distinctly defined and stained blue, this colour being apparently the result of the combined action of the two staining reagents. The lamina of the scale (*d*) is for the most part extremely thin, but in the region of the central substance the upper and lower layers (*a* and *b*) separate from each other, giving rise to a cavity in which the central substance is seen in section as an oval or fusiform body in contact with the upper layer, a clear space being left between the central substance and the lower layer of the scale. The body itself tapers off distally and proximally, and frequently shows clefts in its substance which have no visible relation with any structural feature. In the neighbourhood of each of its thinned or pointed extremities there is an appearance as of a small accumulation of granules which seem not to share in the blue staining. These no doubt are the "granules" which were noted as visible in the scale mounted in balsam and observed on the flat, but it may be doubted whether they are due to anything more than irregularities of the surface of the lamina.

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* See p. 387, *infra*.

Transverse sections under similar treatment show corresponding appearances. In those sections that have passed transversely through the central substance, the clear interval between this substance and the lower layer of the scale is readily seen; the substance itself is fusiform in outline, and a similar or more marked appearance of unstained "granules" occurs at each extremity. A faint beading on the upper layer in the region of the central substance indicates the delicate ribs seen when the scale is examined on the flat. Both beading and "granules" are probably the ridges or ribs of the upper surface of the scale in cross section. In a few cases the under surface of the cavity containing the central substance appears in transverse section to be slightly beaded. The nature of the central substance is uncertain, but the appearance it presents both in the stained and unstained condition is consonant with Dr. Eltringham's suggestion that it represents an accumulation of dried secretion.

In scales that have been doubly stained in light green and safranin and mounted in Canada balsam, the footstalk and accessory disc are coloured pink, whereas the central body, as before noted, is stained blue or greenish blue. The latter colour is also generally to be found at the central region of the base of the lamina, this being the part which marks the insertion of the footstalk.

When the scale is examined on the flat, with the lower surface uppermost, the accessory disc is usually seen to be superposed upon the lamina, the footstalk being so curved as to bring it into this position. If the upper surface is above, the condition is of course reversed, and the accessory disc is seen through the superposed lamina. In either case, the termination of the footstalk in the disc is quite abrupt, and is in apparent connection with a peculiar area of the disc, oval in outline and surrounded by a chitinous ring which seems to be beaded. This, as will be seen later, is probably an aperture. The distal end of the footstalk, at its junction with the lamina, is laterally expanded, becoming trumpet-shaped in outline. A longitudinal section shows that the lamina, footstalk and disc form an S-shaped curve; the footstalk being directed upwards from its origin in the disc, bending sharply over the upper margin of the disc, and then turning downwards to reach the point where it passes into the lamina (Pl. XVI, fig. 1, *c*; fig. 4, *e*, *a*, *b*). Here again there is a sharp bend (fig. 4, *b*), the lamina itself being parallel with this distal portion of the footstalk.

Some of the appearances presented by lamina, footstalk and disc are not easily interpreted; I think, however, that there is little doubt that the footstalk really arises from that surface of the disc which lies next to the wing membrane; that surface, consequently, which in the normal position of the parts is furthest from the lamina. What the relation may be between the origin of the footstalk and the chitinous oval ring mentioned above is doubtful; I am strongly inclined, however, to think that while the footstalk arises from what may be called the ventral surface of the disc, *i. e.* the surface which lies next to the wing-membrane, the chitinous ring bounds an aperture belonging to the other, or dorsal surface. In *Ganoris rapae* Linn., the footstalk has a marginal origin from the disc; and a notch or aperture is visible, indenting the margin at a point opposite to the origin of the footstalk.* If the disc of *P. liliana* really possesses an aperture homologous with the aperture or notch in *G. rapae*, we must suppose that the disc in the former case is flattened at right angles to the plane of the disc in the latter. With respect to the interpretation of these appearances, it may further be noted that in many Pierine genera, e. g. *Nepheronia*, *Pieris* and *Appias*, the accessory disc can frequently be seen to carry an indentation similar to that in *G. rapae*, and like that feature, suggesting a proximal aperture.

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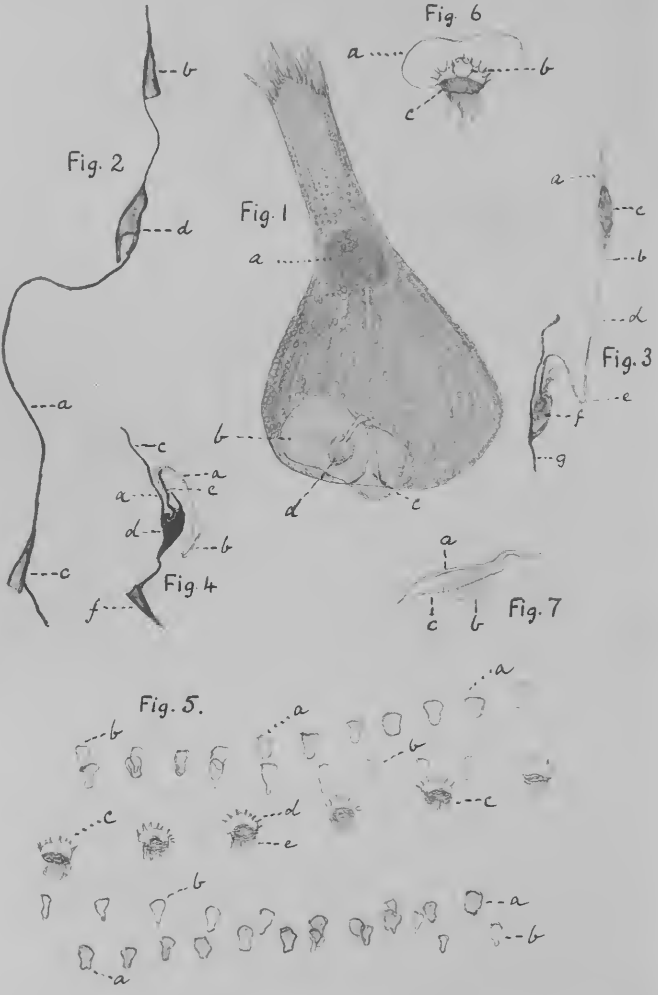
* See Proc. Ent. Soc. Lond., 1909, Pl. D, fig. 4.

When the wing-membrane of *P. liliana* has been denuded of scales, three kinds of socket for the reception of the footstalks of the scales come into view. Those for the ordinary scales are simple funnel-shaped structures, arranged for the most part in parallel rows nearly at right angles with the axis of the wing, and differing in aspect according to whether they belong to the upper or lower surface; those of the former being more amply surrounded by chitinous folds of the membrane, and so presenting a darker appearance. In addition to the ordinary sockets on the upper surface may also be seen the sockets of the scent-scales. These likewise run in parallel rows, between the rows of ordinary sockets. They are fewer in number than the latter structures, and easily to be distinguished from them; being larger in size, broader in shape and darker in aspect (Pl. XVI. fig. 5, *a*, *b*, *c*). Each terminates distally in a transparent crescentic chitinous lip, which is fringed with a row of spiny projections radiating from its convex margin. Proximally to the fringed lip the socket shows a dark opaque area, roughly oval or circular, which shades off into the general surface of the wing-membrane by a number of striations, parallel with the long axis of the socket, and apparently constituted by chitinous folds. In longitudinal sections of the wing-membrane, the funnel-shaped contour of the ordinary sockets of both upper and lower surface is clearly seen; it can also be recognised that the former are set at a somewhat steeper angle to the membrane than the latter, which are more nearly in the plane of the wing (Pl. XVI, fig. 2, *b*, *c*). The sockets of the scent-scales are again easily distinguishable by their larger size and the projecting lip, which is now seen in profile (fig. 2, *d*). A similar lip is visible on the side of the socket which abuts on the wing-membrane; the latter, however, projects from the main body of the socket to a much smaller extent than the former; it also appears to be devoid of the marginal row of spines. These lips may be called "upper" and "lower" respectively; together they form a rim which appears to be continuous round the mouth of the socket.

In a partially denuded wing examined on the flat, the accessory disc of each scent-scale is seen to be engaged in its appropriate socket (Pl. XVI, fig. 6). The disc is much larger than its receptacle, and the only part that is actually included within that structure is a semicircular or segmental area occupying the middle of the proximal edge of the disc. When seen in longitudinal section, the disc appears to fit into a groove between the upper and lower lip of the socket; its proximal margin being curled over towards the lower lip, in contact with the main substance of the socket. In a fortunate section the footstalk may be seen to wind over the distal edge of the disc, and to lie in close juxtaposition with its lower surface (Pl. XVI, fig. 4). Before reaching the curled-over part of the disc it disappears, having apparently become fused with the disc about midway between the proximal and distal edges. I have never succeeded in identifying any appearance in these longitudinal sections as due to the aperture. In transverse sections, the ordinary sockets appear simply as chitinous rings, each enclosing a circular or oval lumen. The sockets of the scent-scales, besides being much larger, are distinguishable by the fact that they show a central body oval in outline and staining readily, in place of the orifice visible in the ordinary sockets. This central body is surrounded by a less deeply stained zone, also oval in outline, and somewhat irregular if the section has happened to pass through the socket near its insertion in the wing-membrane. In many of the sections the disc is seen as a beaded line crossing the socket in the direction of the long axis of the latter, and projecting for a considerable distance at each end (Pl. XVI, fig. 7). I have never been able to satisfy myself that the footstalk is recognisable in these transverse sections.

It is probable that the examination of material properly treated while fresh would clear up many points which are obscure in the dry condition. I am hoping that it may be possible to obtain in course of time some specimens of *P. liliana* which have been put at once into preservative reagents. Meanwhile the facts at present observed seem to be sufficiently interesting to be placed on record in this brief communication.

I am greatly indebted to my friend Dr. H. Eltringham for the care and skill which he has employed in making the sections described and figured in the present paper.



F. A. D. del.

SCENT-SCALE OF PINACOPTERYX LILIANA.

EXPLANATION OF PLATE XVI.

FIG. 1. The scent-scale of *Pinacopteryx liliana* Grose-Smith, viewed on the flat, × 500.

- *a.* Central granular area.
- *b.* Accessory disc, superposed upon the lamina, the scale being viewed from beneath.
- *c.* Trumpet-shaped distal expansion of the footstalk at its junction with the lamina.
- *d.* Aperture of the disc, surrounded by its chitinous ring.

FIG. 2. Longitudinal section of fore-wing, × 500.

- *a.* Wing-membrane.
- *b.* Socket of ordinary scale of under-surface.
- *c.* ,, ,, ,, upper-surface.
- *d.* Socket of scent-scale, showing upper and under lip.

FIG. 3. Longitudinal section of scent-scale and socket, × 500.

- *a.* Lower layer of scale.
- *b.* Upper layer of scale.
- *c.* Central substance, situated in the dorsal portion of the cavity enclosed between the upper and lower layers of the scale.
- *d.* Lamina of the scale.
- *e.* Junction of lamina with footstalk.
- *f.* Socket of scent-scale enclosing accessory disc.
- *g.* Wing-membrane.

FIG. 4. Longitudinal section of scent-scale socket and footstalk, × 500.

- *a.* Footstalk, arising from about the centre of the ventral surface of the disc, and curling dorsally over the upper margin of the disc.
- *b.* Base of lamina close to the insertion of the footstalk.
- *c.* Wing-membrane.
- *d.* Socket, showing upper and lower lip.
- *e.* Accessory disc.
- *f.* Socket of ordinary scale of lower surface.

Fig. 5. Portion of denuded wing-membrane seen on the flat, × 310.

- *a, a.* Sockets of ordinary scales of upper surface.
- *b, b.* ,, ,, ,, lower surface.
- *c, c.* Sockets of scent-scales.
- *d.* Upper lip with chitinous spines.
- *e.* Dark opaque area of socket.

Fig. 6. Socket of scent-scale with engaged accessory disc, seen on the flat, × 500.

- *a.* Accessory disc in outline.
- *b.* Aperture of accessory disc.
- *c.* Socket, showing upper lip with chitinous spines.

Fig. 7. Transverse section of socket of scent-scale with accessory disc in place, × 500.

- *a.* Wing-membrane.
- *b.* Socket.
- *c.* Accessory disc lodged in socket.

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Report, p. 511.

Mr. W. A. Lamborn's Observation on Marriage by Capture by a West African Wasp. A possible explanation of the great variability of certain secondary sexual characters in males. *By* Professor E. B. Poulton, *F.R.S.*

A letter recently received from Mr. W. A. Lamborn, Entomologist to the Agricultural Department of Southern Nigeria, records the following interesting observation made near Ibadan :—

'On July 10, 1913, a large clay nest was found attached to the under side of a Kola leaf. On the nest was a large wasp which had enormously developed mandibles, and flying to and fro close by were two other wasps. These last attempted to alight on the nest, but as soon as they did so the wasp in possession opened its jaws, buzzed angrily, and made a rush at them, whereon they beat a hurried retreat. This happened many times. Closer examination showed that the wasp was guarding a small hole at one side of the nest, at which I could see the head of a newly-emerged imago at work gradually enlarging the opening. . . . The confined imago made a sudden exit and fell, but the wasp on guard was so fully on the alert that it secured the falling insect with its legs and both came to the ground together. I am of opinion that it attempted to effect coitus, but in my anxiety to view satisfactorily the proceedings I approached too near, with the result that it took the alarm and flew up. I secured it, but the newly emerged wasp, the supposed female, escaped me. Meanwhile four more wasps were buzzing near the nest, and of these I managed to get two. I believe that these are males also, and I notice an astonishing difference in the degrees of mandibular development. The male with the largest pair obviously terrorised the others by virtue of possessing them, and, but for my interference, would have owed his success to this, for the case was definitely one of marriage by capture. The nest still contains three cells, and so I am hoping, if a female comes out, to be able to test for the assembling of males.'

It is impossible to imagine an observation that would have interested Charles Darwin more deeply than that recorded above by Mr. Lamborn.

There can be no doubt that the species of wasp is *Synagris cornuta*, Linn., the very name of which obviously refers to the enormous horn-like outgrowth from the base of the mandible in some of the males. There is the same immense difference between the degrees of development spoken of by Mr. Lamborn, the outgrowth being of various sizes and sometimes only represented by a small tubercle. The females are very rare compared with the males—only one to about twenty in the British Museum of Natural History. Curiously enough, I had, only a few weeks ago, suggested observations on the part played in courtship by the mandibles of these very males to another friend who had brought specimens home with him from Sierra Leone, and was returning later in the year. But Mr. Lamborn, with his wonderful powers of observation, does not let much escape him.

It is suggested as a probable hypothesis that these immense horn-like outgrowth sticking straight out in front of the face are a disadvantage in obtaining food and perhaps in other ways in the struggle for life, and that the emergence of the females covers a period long enough for this struggle to tell, so that the males with small or rudimentary horns have the advantage in the end through the operation of natural selection, while the others have the advantage at the beginning through sexual selection, in the form of battles between the males.

I have written to Mr. Lamborn asking if he will carry out a series of observations in order to test this hypothesis.

A remark of the late Edward Saunders, F.R.S., the great Hymenopterist, will indicate the impression made by these extraordinary male characters which might be taken for 'monstrosities' did we not know that they are normally present in many males. We were glancing through the boxes of his father's collection in the Hope Department, at Oxford, when we came upon a male *S. cornuta*—a specimen from Fernando Po. 'Why,' said Edward Saunders, 'it is a biological education to look at that insect!'

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